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NAVAL POSTGRADUATE SCHOOL
Monterey, California

Analysis, Design, and Prototype Implementation of a Contemporary Information System for the Marine Corps Institute

by

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February 1997

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Prepared for: The Marine Corps Institute
Washington Navy Yard
912 Poor Street S.E.

NAVAL POSTGRADUATE SCHOOL
Monterey, California

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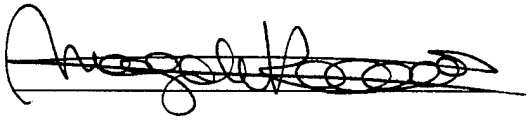

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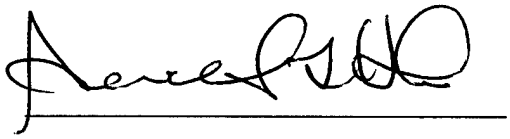

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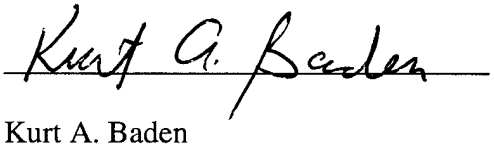

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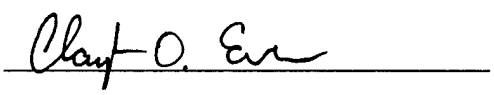

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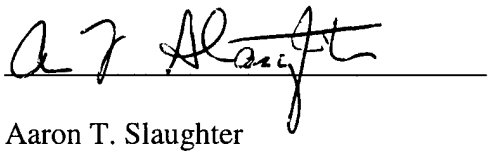

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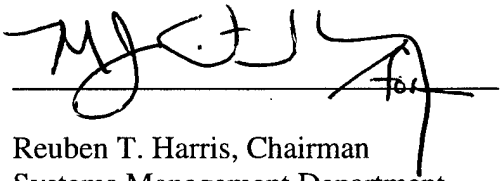

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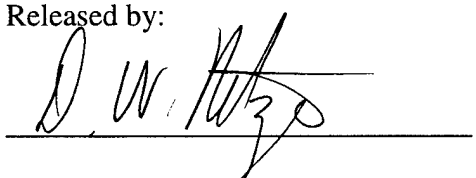

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13. ABSTRACT (Maximum 200 words.)
This report develops an enterprise-wide architecture for the use of information systems in support of the MCI activities. The overall architecture is specified by defining three types of architectures. *Data Architecture* defines the major kinds of data needed to support MCI business. IDEF1X modeling is used to represent data. *Functional Architecture* defines the major functions of the enterprise needed to manage the data. IDEF0 modeling is used to represent this architecture. *Technology Architecture* defines the technology platform needed to provide an environment for the applications that manage the data and support business functions. In addition to defining the architectures, a set of matrices is developed showing the relationship between entities, functions, organization units and locations. The information provided by these matrices is intended to challenge management to think about its structure, mission, goals, and the information needed to run MCI business.

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Executive Summary

Background

This report develops an enterprise-wide architecture for the use of information systems in support of the MCI activities. The overall architecture is specified by defining three types of architectures:

1. *Data Architecture:* Defines the major kinds of data needed to support MCI business. IDEF1X modeling is used to represent data.
2. *Functional Architecture:* Defines the major functions of the enterprise needed to manage the data. IDEF0 modeling is used to represent this architecture.
3. *Technology Architecture.* Defines the technology platforms needed to provide an environment for the applications that manage the data and support business functions.

In addition to defining the above architectures, a set of matrices is developed showing the relationship between entities, functions, organization units and locations. The information provided by these matrices is intended to challenge management to think about its structure, mission, goals, and the information needed to run MCI business.

Subsequent efforts will develop detailed data and process models for the Student Services Functions and the associated design specifications for development of information systems applications to support Student Services.

Conclusions

1. The development of an enterprise wide model and detailed data and process business area models are the necessary building blocks for developing any information system, without which the success of a project is doubtful.

2. A detailed process analysis of a business area provides an opportunity for the redesigning/reengineering of certain processes to reduce costs, improve efficiency, and better meet the needs of the customers.

3. Client/server, open systems, relational technology, and graphical user interface technologies are the direction which the IT industry is heading and should form the basis of selecting any future target platform.

4. To successfully manage risk and change and given the deep roots of the current legacy system and infrastructure, it is not advisable to migrate to the target architecture in one step. Rather, a phased methodology should be adopted to minimize the number of variables to be changed, thus increasing the probability of success.

Recommendation

1. Adopt a phased approach to upgrade the current technology platform. The first phase consists of upgrading the HP 3000 minicomputer and using it as a server, installing a new Oracle DBMS under the current MPE/ix operating system, and replacing the current dumb terminals with client pentium level microcomputers. The second phase incrementally migrates to a true open system architecture and consists of an Intel-based server, Windows NT operating system, Oracle DBMS, and state-of-the-art microcomputer clients.

2. Assemble or contract for a high caliber, well-trained programming/implementation team proficient in the development environment of choice and provide enough overlap with the NPS analysis and design team to minimize misinterpretation of requirements and facilitate a smooth transition.

3. Develop, in cooperation with NPS, a detailed migration plan for hardware, software, data, procedures, and personnel. An important aspect of the plan is user training for the new environment.

4. Establish a priority and schedule for developing, refining, and reengineering the business area process, beyond the student services functions, according to the business areas identified in this study.

5. Examine the set of high level matrices developed in this study that show the relationship between entities, functions, organization units and locations. Use the information obtained from the matrices to review the mission, functions, goals, organization structure, and the information needed to run MCI business.

I. Introduction

A. Background

The Marine Corps Institute was established to "develop, publish, distribute, and administer distance training and education materials to enhance, support, or develop required skills and knowledge of Marines and to satisfy other training and education requirements as identified by the Commanding General, MCCDC." To accomplish its mission, MCI is organized into seven functional departments: education & operations, student services, occupation specialty, professional military education, production, and logistics departments.

The student services department mission is to support the enrollment, grading and management of the Marine Corps distance education and training programs. In support of its mission, the student services department employs an automated information system (AIS) to automate the actions required to support a student in the MCI correspondence program, maintain student records, and produce necessary management reports. The automated system, known as the Marine Corps Institute Automated Information System (MCIAIS), is a legacy system developed in the late 1970's. It runs on a Hewlett-Packard 3000 mini computer running MPE/iX operating system. MCIAIS is written in HP proprietary language "Transact" and accesses a Turbo-IMAGE hierarchical database.

As typical of many legacy systems, MCIAIS suffers from many shortcomings:

1. It has over 110 "spaghetti coded" programs that are difficult to maintain, modify, and upgrade

2. It does not have an underlying data or process models
3. Programs have:
   - Poor functionality
   - Poor checks and balances
   - No statistical analysis capability
   - Limited "ad hoc" query capability
4. It utilizes a "closed" non-relational database
5. It does not support Graphical User Interfaces
6. It does not follow DoD or USMC standards

In response to these shortcomings, MCI initiated a project to redesign and rewrite MCIAIS using an open hardware and software architecture. In addition MCI is also

reviewing and redesigning the business processes to better support its mission and current advances in training and education.

B. Objectives

The objective of this research project is to support MCI in transforming their current legacy information system into a modern environment that can take advantage of "open" technologies. Specifically the effort will 1) perform a detailed analysis of data and process requirements, 2) review existing SSD processes and redesigning them to increase efficiency and reduce costs, 3) develop a target hardware and software architecture based on open systems, 4) provide assistance in the implementation of the new system, 5) develop a migration plan from existing legacy system to new system.

C. Scope

The scope of this report is the development of an enterprise-wide data, process, and technology architectures for the use of information in support of the MCI activities. Subsequent efforts will develop detailed data and process models for the Student Services Functions and the associated design specifications for the development of information systems applications to support Student Services.

D. Methodology

The approach adopted for the development of the enterprise-wide model for MCI follows closely the Enterprise Architecture Planning and Information Engineering Methodologies. It develops the overall architecture by defining three kinds of architectures:

Data Architecture: Defines the major kinds of data needed to support MCI business. IDEF1X modeling is used to represent data.

Process Architecture: Defines the major kinds of processes needed to manage that data and support the business functions. IDEF0 modeling is used to represent this architecture.

Technology Architecture. Defines the technology platforms needed to provide an environment for the applications that manage the data and support the business functions. In addition to defining the above architectures, a set of matrices are developed that show the relationship between entities, functions, organization units and locations. The

information provided by these matrices is intended to challenge management to think about its structure, mission, goals, and the information needed to run MCI business.

E. Organization of Report

This report is organized as follows:

Chapter II presents the Enterprise Business Model. This includes documenting the organization structure, business locations, and business functions and the relationships between them.

Chapter III presents the Enterprise Data Model. This includes the high level entities (subject areas), their attributes, and the relationships between the entities. The relationships between data entities, organization units, locations, and business functions is also developed.

Chapter IV determines what functions create/read which entities by developing a Create/Read (CR) business functions vs. high level entities matrix. This matrix is then clustered to reveal the major information subsystems to support the enterprise.

Chapter V presents the enterprise technology platforms and proposes three options, with associated costs, for migrating the current legacy system to a contemporary, client/server open system.

Finally, Chapter VI summarizes the report and presents some conclusions.

II. Enterprise Business Model

This chapter creates the enterprise business model for MCI. It follows the guidelines of the enterprise architecture planning methodology outlined by Steven H. Spewak in his book, Enterprise Architecture Planning. The steps of the Spewak methodology for creating an enterprise business model are: 1) document the organization structure, and 2) identify and define the business functions. The remainder of this chapter explains the steps in greater detail.

A. Document the Organization Structure

This step documents the structure of the organization and identifies the location that perform the business functions. To successfully complete this step, it is important to identify individuals to interview and determine the extent of data and application system sharing. Data was collected in several ways. Before the first interview, team members studied the read-ahead package provided by MCI. The package included existing organizational structure, an incomplete business model that had been done previously by an independent contractor, a collection of existing data dictionary entries, existing data dictionaries, task breakdown of the Student Services Department, and documentation and background information about the Marine Corps Institute.

1. Identify Business Stake Holders

An organization chart was provided by MCI along with a telephone directory and e-mail contact information. Department chiefs were identified and introduced at the initial planning meeting in August 1996. See Exhibit 1, Appendix A for an MCI organizational chart.

2. Interview Users and Developers

Following the MCI departmental briefs, team members interviewed the department chiefs as well as telephone operators from the student services department and computer programmers in the information systems department. After the in-brief the team conducted additional in-depth interviews, to ask additional questions and gather more information.

3. Documentation, Input Screen, Output Report Review

Additional documentation, training manuals, SOPs, existing input screen shots, and management reports were collected to enhance the information gathered during interviews and help to clarify the business rules.

4. Identify and Define Business Locations Where the Functions Take Place

A tour of the MCI headquarters in August revealed the location of the MCI offices and work spaces where the various business activities take place. Exhibit 3, Appendix A show the MCI organizational units, locations, and relationship between them..

B. Identify and Define the Business Functions

1. Identification and Definition

A *business function* is a collection of any set of actions performed in the course of conducting business. Business function definitions exist to understand the business process as a whole. They are the very essence of the business but do not include every detail of the business process. Business process details are added during the Business Area Analysis (BAA). At the enterprise level, business function definitions do not show who performs the function, how the function is performed, where the function is performed, when the function is performed, the importance or priority of the function, the technology or resources used by the function, or the flow of inputs outputs or personal interactions of the function. The MCI enterprise level business functions are defined in Exhibit 2, Appendix A.

2. Relate the Business Functions to the Organizational Units That Perform Them

To ensure that all business functions were included in the analysis, several matrices are generated. These include the organization versus location, organization versus function, and location versus function matrices. These matrices show the extent to which

departments share data or perform redundant functions. These matrices are included as exhibits in Appendix A.

Matrix	Exhibit #, Appendix A
Organization vs. Location	Exhibit 3, Appendix A
Organization vs. Function	Exhibit 4, Appendix A
Location vs. Function	Exhibit 5, Appendix A

C. Conclusion

This set of high level matrices show the relationship between functions, organization units and locations. The information obtained from the matrices can be analyzed to redefine the mission, functions, goals, organization structure, and the information needed to run MCI business.

III. Enterprise Data Model

This chapter presents the enterprise wide data model for the Marine Corps Institute (MCI). Section A describes the general methodology used for developing the conceptual data model. Section B describes the specific enterprise wide model designed for MCI. It is important to note that this chapter describes the enterprise wide MCI model. A subsequent report will focus on the data model designed to support the Student Services Department (SSD) and the Management Information Systems (MIS) Department.

A. Methodology for Developing the Data Architecture

This section presents the strategy used for the development and distribution of the data architecture in a client/server environment. The methodology used for developing the data architecture is a four step process. The steps of the process are: 1) list candidate data entities, 2) define the entities and their associated attributes and relationships, 3) develop the data model, and 4) relate the entities to the business functions. The flowchart of Figure 3-1 illustrates this process.

1. List Candidate Data Entities

The first step in the development of the data architecture for a client-server based information system is to list the candidate data entities. This process begins with the study of the existing data sources. This is accomplished by: 1) collecting information by distributing questionnaires, interviewing developers, administrators, and end-users; and 2) studying existing system documentation, screens, and reports.

a. Questionnaires and Interviews

Analysis begins with the distribution of questionnaires and the conduct of interviews with developers, programmers, administrators, and users of the current database. Interviews are especially useful. Interviews with database developers and administrators focus on the structure, functions, and modification of the existing database. Interviews with users focus on the applications and processes which access the data. User interviews are useful in identifying data elements used in manual processes that should be modeled in order to automate these processes. Whenever possible, on-site interviews are conducted. They afford the opportunity for direct analysis of data, interviewing the largest number of key participants, and allow for a demonstration of the existing system. Additionally, copies of all available documentation are on hand. Follow

up communications is accomplished by scheduling telephonic conferences, as well as the exchange of electronic mail.

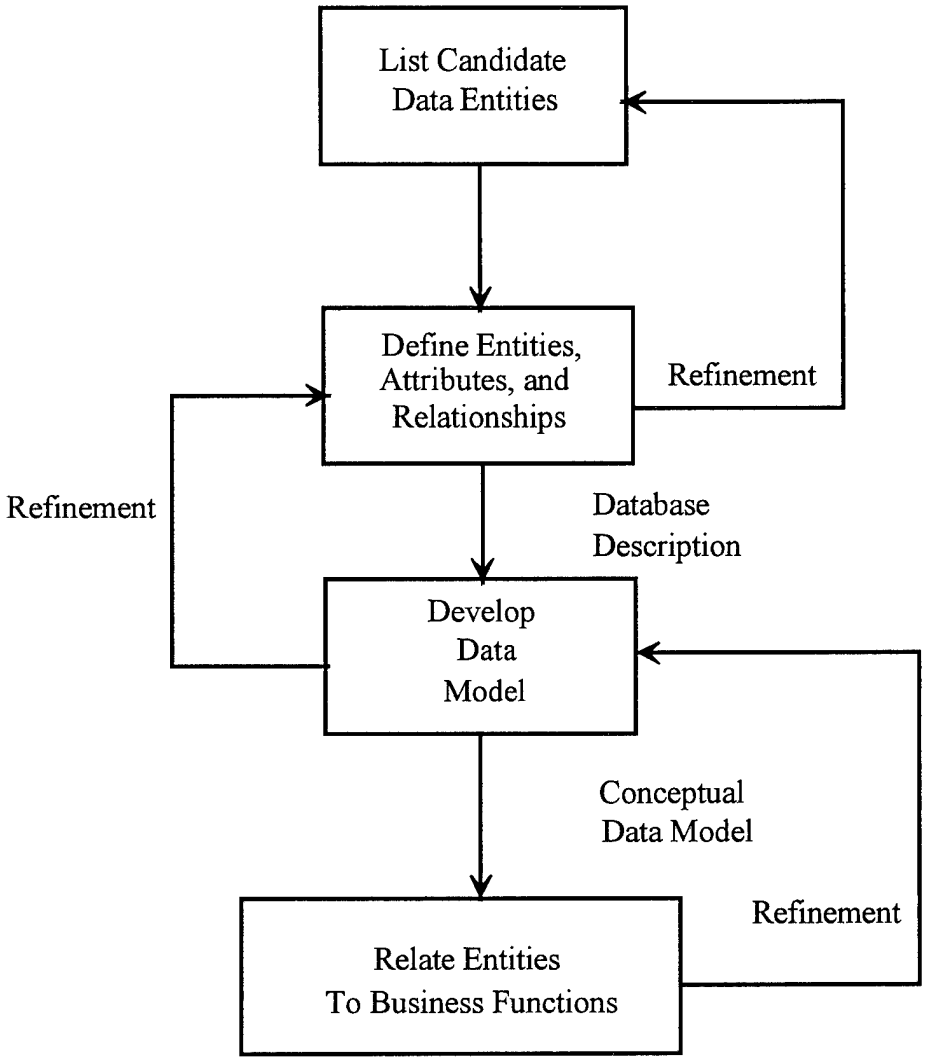


Figure 3-1

b. Documentation, Input Screens, and Output Report Review

Information gathered from documentation, user input screens, and output reports augments the data collected from the developer and user interviews. All available

information on existing data structures, data types and definitions, database interface and download procedures, and data process definitions is reviewed. User input screens further reveal data needs as well as the structure of existing data. Data dictionaries are reviewed. Information stored, accessed, and updated manually is examined in detail, and this information is grouped into appropriate entities in order to facilitate the automation of manual processing. Review of existing processes is done in conjunction with business process re-engineering team members, as the development of the future data model supports their re-engineering effort. Output reports are reviewed with end-users to determine their usefulness and any data elements contained in them which are not considered useful. Additionally, users are asked to identify reports not currently available which would be desirable in the future system.

c. Develop Candidate Entity List

Based on the collected background information, a candidate entity list is drafted. This list is the basis of the enterprise wide data model. It may be refined during subsequent development stages.

2. Define The Entities and Their Associated Attributes and Relationships

Once the candidate entities are listed, they must be clearly defined. Additionally, candidate attributes for these entities are developed and defined. Many of the candidate attributes will be identified during the analysis of the existing system. Once identified, the attributes must be defined. Finally, the relationships between the entities must be identified and defined.

It is not necessary that all attributes and relationships be listed and defined at this stage. Additional attributes and relationships will reveal themselves throughout the development process. At a minimum, primary keys must be identified during this stage. Primary keys are explained in section three below.

3. Develop the Data Model

The most effective means of communicating the structure of a database is through the use of a conceptual data model. There are several commonly used modeling techniques that have been standardized and are easily understood. For this project, Integration Definition for Information Modeling (IDEF1X) was selected as the modeling technique. IDEF1X has been standardized by the National Institute of Standards and Technology (NIST) as documented in the Federal Information Processing Standards (FIPS) Publication 184. As such, IDEF1X is the standard modeling technique for use by the federal government,

including the Department of Defense. The following section presents a brief overview of the IDEF1X Model.

a. IDEF1X Model

The IDEF1X model is a simple modeling technique for database design. Though not as common as the Entity-Relationship (E-R) diagram technique, the IDEF1X technique has the advantage of being standardized by NIST. As such, it provides a method of insuring that the design of the conceptual model is understood by all involved parties.

Unless otherwise stated, the IDEF1X modeling features used in this project are in compliance with FIPS PUB 184. Background and history on the IDEF family of modeling techniques is available in that publication.

IDEF1X was developed to meet the following requirements.

1) Support the development of conceptual schemas. The IDEF1X syntax supports the semantic constructs necessary in the development of a conceptual schema. A fully developed IDEF1X model has the desired characteristics of being consistent, extensible, transformable, and expandable.

2) Be a coherent language. IDEF1X has simple, clean, consistent structure with distinct semantic concepts. The syntax and semantics of IDEF1X are easy to grasp, yet are robust enough to satisfy most project needs.

3) Be teachable. IDEF1X is easily taught to users and customers not familiar with semantic data modeling. It can easily be understood by management information system professionals, as well as executive level supervisors, end users, application developers, and other project team members.

4) Be well-tested and proven. IDEF1X is based on many years of experience with predecessor techniques, and has been tested in numerous Air Force development projects, as well as in private industry.

5) Be automatable. IDEF1X diagrams can be generated automatically by many CASE tools, including ER*win*®, a forth generation CASE tool marketed by Logic Works®. Additionally, ER*win*® has the advantage of being capable of generating Structured Query Language (SQL) based conceptual schemas for a variety of target databases and database servers. These schemas can include a variety of referential integrity triggers and indexes to insure both data integrity and performance optimization.

The IDEF1X model consists of three basic constructs.

1) Things about which data is kept, e.g., people, places, ideas, events, etc., as represented by a box (these boxes are commonly referred to as entities).

2) Characteristics of those things as represented by attribute names within the box. ER*win*® provides the ability to also represent, for each attribute, the associated data type and field length in the language of the target database. Though this is not in accordance with FIP PUB 184, we have chosen to graphically depict the associated data type and field length for each attribute in our model. This is done to provide clarity to the model.

3) Relationships between those things, represented by lines connecting the boxes.

Attributes contain detailed information about entities. Attributes can be single valued, such as the course number for a particular course, or multi-valued, such as the phone numbers in a particular office. Additionally, attributes may be composite (i.e., composed of several single value attributes) such as the composite attribute address, which is composed of house or apartment number, street, city, state, and zip code attributes.

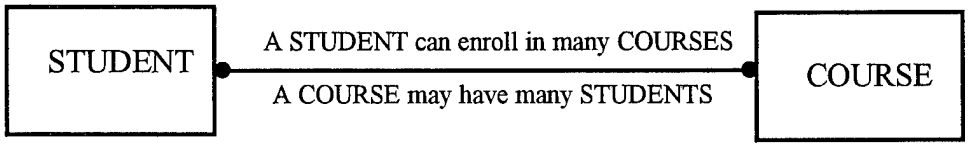
An attribute, or combination of attributes, must exist for each entity which will uniquely identify an instance of that entity. This attribute (or combination of attributes) is known as the entity's ***primary key***. If the primary key is a combination of attributes, it is known as a composite key. If other unique attributes exist, but are not designated as the identifying attribute, they are known as alternate keys.

When two entities are related, their relationship is identified through the use of these key fields. This is done by embedding the primary key of one entity into the entity to which it is related. For example, if there are two entities STUDENT and RUC/MCC, the relationship is clearly described as a RUC/MCC has many STUDENTS, but a STUDENT may belong to one and only one RUC/MCC. In this case the primary key from RUC/MCC (RUC/MCC_ID) would be embedded in each instance of STUDENT belonging to that RUC/MCC. These embedded keys identify which students belong to a particular RUC/MCC. They are known as ***foreign keys***.

A foreign key may be the primary key (or part of the primary key) of the entity in which it is embedded. If that is the case, the relationship is said to be an identifying relationship. If, however, the foreign key is not needed to uniquely identify the entity in which it is embedded, the relationship is said to be non-identifying. In the example above, a STUDENT is uniquely identified by his social security number (SSN_ID), and does not depend on the foreign key RUC/MCC_ID for his identity. This relationship would be a non-identifying relationship.

Relationships define the associations between attributes. Associations are characterized by ***degree***, ***cardinality***, and ***participation constraints***. ***Degree*** defines the number of entities involved in a relationship. Most relationships are binary in nature (the STUDENT_COURSE example in Figure 3-2 is binary in nature). Some relationships

may be of greater degree. The relationship between child and parent, for example, is tertiary in nature. A child has two parents.



Above, the "many-to-many" relationship between students and courses is depicted. This is a binary relationship, as it involves only two entities.

Figure 3-2

Cardinality refers to the number of instances each entity involved in the relationship. Minimum cardinality refers to the minimum number of instances of an entity that may be involved in a relationship. Maximum cardinality refers to the maximum number of instances of an entity that may be involved in a relationship. Using the student-course relationship from Figure 3-2 as an example, zero, one or many students may take zero, one, or many courses. In this example, zero is the minimum cardinality and many is the maximum cardinality of both student and course. Commonly, minimum cardinalities are not referred to when describing relationships. Thus, the relationship of students to courses would be described as a "many - to - many" relationship.

Participation constraints indicate whether the existence of an entity depends on it being related to another entity through the relationship type. In IDEF1X, entities constrained by participation are known as dependent entities. Their existence is said to depend on the existence of another entity. In IDEF1X, entities are said to be either dependent or independent. Independent entities are said to be parents, and their dependent entities are known as children. Some of the common IDEF1X modeling symbols are diagrammed in Figure 3-3. A complete listing of these symbols, as well as their associated definitions is included in FIBS PUB 184.

Additionally, some relationships involve entities which share common characteristics. These are referred to as ***generalization*** or ***inheritance*** hierarchies. They are also referred to as ***sub-type relationships***. For example, we might find during a modeling project that several different types of PERSONNEL exist in an organization, such as COURSE_WRITERS, CUSTOMER_SERVICE_REPS, and WAREHOUSEMEN. A generalization entity called PERSONNEL is formed to represent information common to all three types of PERSONNEL. The relationship would be expressed as, "a person may be a course writer, customer service representative, warehouseman, or other."

A generalization hierarchy may be complete or incomplete. For example, a generalization entity may exist called PERSONNEL with two sub-type entities, MALE and FEMALE. This would be a complete structure, as all personnel must be either male

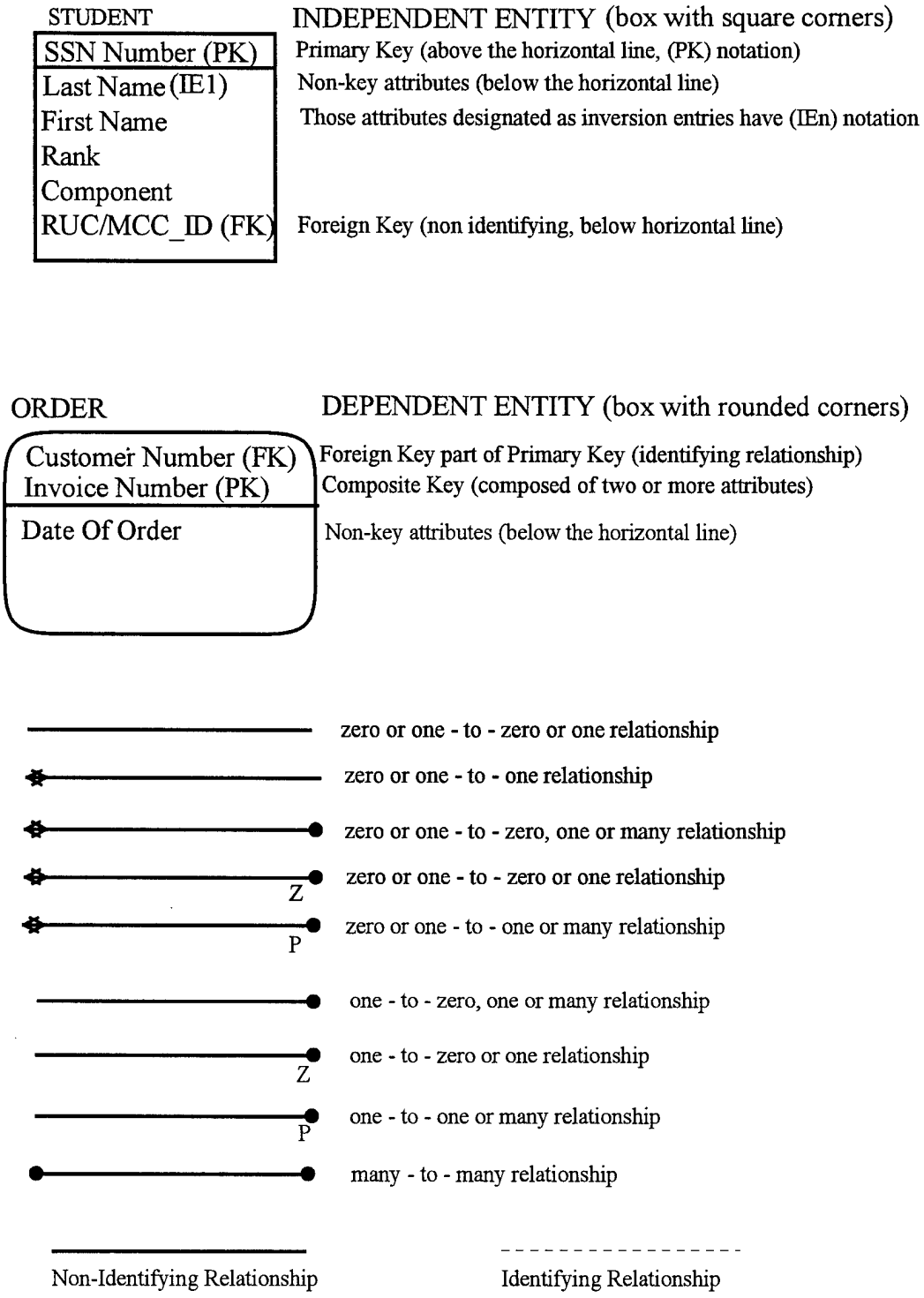

STUDENT
SSN Number (PK)
Last Name (IE1)
First Name
Rank
Component
RUC/MCC_ID (FK)
INDEPENDENT ENTITY (box with square corners)
Primary Key (above the horizontal line, (PK) notation)
Non-key attributes (below the horizontal line)
Those attributes designated as inversion entries have (IEn) notation
Foreign Key (non identifying, below horizontal line)
ORDER
Customer Number (FK)
Invoice Number (PK)
Date Of Order
DEPENDENT ENTITY (box with rounded corners)
Foreign Key part of Primary Key (identifying relationship)
Composite Key (composed of two or more attributes)
Non-key attributes (below the horizontal line)
zero or one - to - zero or one relationship
zero or one - to - one relationship
zero or one - to - zero, one or many relationship
zero or one - to - zero or one relationship
Z
zero or one - to - one or many relationship
P
one - to - zero, one or many relationship
one - to - zero or one relationship
Z
one - to - one or many relationship
P
many - to - many relationship
Non-Identifying Relationship
Identifying Relationship

Figure 3-3

or female. The same generalization entity may contain the sub-type entities CONSULTANT and CIVILIAN. This structure would be incomplete, as their may be personnel who are neither consultants or civilians.

Generalization Hierarchies may be appropriate for the following three reasons.

1) The entities share a common set of attributes.
2) The entities share a common set of relationships.
3) The categories of an entity should be exposed (modeled as sub-types) if the business demands it, even if the categories have no attributes that are different, and even if they participate in no relationships distinct from other categories.

The symbols associated with generalization hierarchies are illustrated in Figure 3-4.

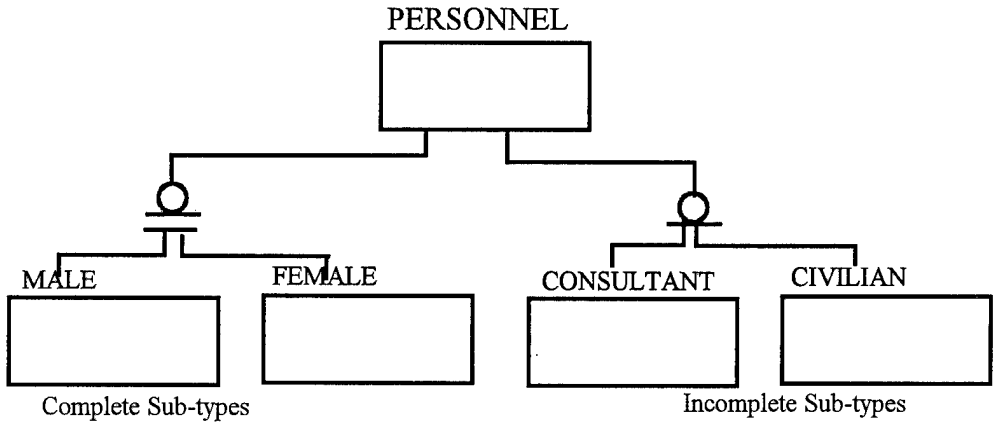


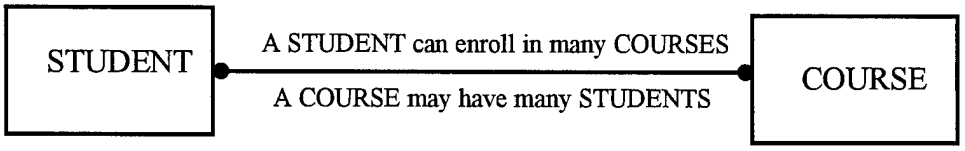
Figure 3-4

b. ERwin® Issues

Commonly in data modeling, entities are defined as items of interest in the user's environment. As such, they are usually real world objects. ERwin® restricts the modeler's use of "many - to - many" relationships for the purpose of schema generation. All "many - to many" relationships must be resolved into "one - to - many" relationships in order to generate schemas using ERwin®. This forces the model to depict conceptual items, which are not real world objects, as entities.

For example, a student can enroll in many courses, and a course can have many students. Both student and course are real world objects and as such, in data modeling terms, would be known as entities. Additionally, they are entities in a "many - to - many" relationship. ERwin® forces the modeler to resolve this relationship into two "one - to -

many" relationships by creating an "association entity" between student and course. This entity might be called "STUDENT_COURSE_X". As a result, the IDEF1X diagram as modeled in ERwin® can easily become cluttered with these association entities, created for the sole purpose of resolving "many - to - many" relationships. This is graphically illustrated in Figure 3-5.



Above, the "many-to-many" relationship between students and courses is depicted.

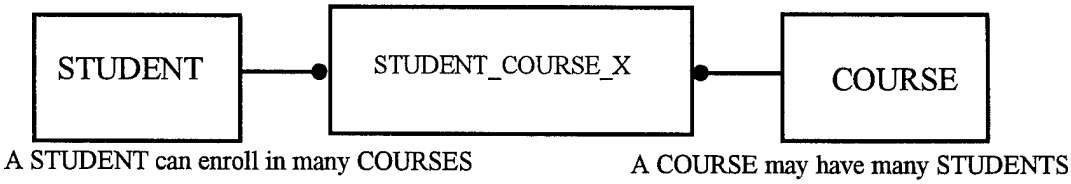


Figure 3-5

Because of this limitation, it is useful to first model the desired system without regard to this somewhat artificial constraint, thereby allowing for the existence of "many - to - many" relationships on the diagram. These relationships can later be resolved into "one - to - many" relationships for the purpose of schema generation. ***The enterprise wide data model depicted in section B of this chapter has unresolved "many - to - many" relationships.***

In Erwin®, some attributes are known as inversion entry attributes. An inversion entry represents an additional way that the user wants to access data. An inversion entry is an attribute or group of attributes which will commonly be used to access the entity, but which may not result in the finding of exactly one instance. For example, consider the entity STUDENT. It may be identified by the key field, Student Social Security Number. However, the user may want to search the entity for a student whose last name is Smith. If the attribute Last Name is designated as an inversion entry, an index will be built on the attribute Last Name, and the user will be able to rapidly access all instances of the STUDENT entity with the Last Name of Smith.

Inversion entry notation is not standardized in FIBS PUB 184, but is a key feature in ERwin®. When inversion entries are designated in an ERwin® model, they cause an index to be built on those designations whenever a schema is generated for a target database. Because of this utility, they are used to designate those fields which, although not unique, are most likely to be searched during database queries.

c. Ad Hoc Designed Databases

Ad hoc databases are those databases which have been designed and/or implemented without the benefit of a conceptual data model. In most, but not all, cases these databases are non-relational. Usually they consist of flat file data files, with a great deal of data redundancy, and no defined relationships. Data manipulation, retrieval, and association is done programatically, and is not based on the data definitions or meta-data contained in the database. Ad hoc query language such as SQL cannot be used, and retrieval of data is often impossible.

When developing a conceptual model for a future system based on an existing ad hoc database, those portions of the ad hoc database that are relevant to the project must be re-engineered in a top down fashion, based on a good deal of investigative work. This investigative work consists of gathering facts about the data and its representations through a study of the database structure files, input forms, output reports, interviews, user screens, and all other available documentation.

d. Formally Designed Databases

Databases which have been formally developed using a conceptual data model are considered formally designed (Kamel and McCaffrey, 1995). These databases are structured relationally, generally are developed using CASE tools such as ER*win*®, and contain detailed data dictionaries and design documentation. An understanding of formal database design is crucial for the maintenance of the future system. In order to maintain the future database, and its accompanying data model, it is necessary that database maintenance personnel clearly understand the principles of IDEF1X modeling, as well as the underlying theory of relational database design.

4. Map Entities to Functions in the Process Model

After the initial identification of target entities, these entities are mapped to functions in the business process model which have been identified by the business process re-engineering team. The business process re-engineering team groups functions by related entities. As these functions are grouped and refined, the major sub-systems emerge. During this process, entities are refined, broken into sub-entities, and the normalization of the data model is accomplished. No entity should exist that is not

created, read, updated, deleted or archived by a function identified during the business process analysis. Additionally, all automated business processes must be supported by the underlying database.

a. Map Entities to Business Functions

In this step, high level entities are clearly defined to the process re-engineering team. These entities are mapped, in the form of a CRUD matrix, to the business functions. In the CRUD matrix, a "C" designates data subjects that are created by a function, an "R" those data subjects that are read by a function, a "U" those data subjects that are updated by a function, a "D" those data subjects that are deleted by a function, and an "A" those data subjects that are deleted by a function.

In order to accomplish this mapping, both entities and functions must be clearly defined. High level entities are referred to as ***data subjects***. The collection of data subjects should encompass all of the people, places, and things for which data must be stored in the organization.

Before beginning the mapping process, it is useful to map the data subjects to organizational units, and to physical locations at the enterprise. These matrices greatly assist in the process of mapping data subjects to functions.

b. Refine the Conceptual Data Model

Throughout the development process, the conceptual data model is refined and normalized. Entities are broken down to resolve remaining "many - to - many " relationships, and normalization is achieved. Normalization is the process of breaking entities into two or more sub-entities to ensure that all the attributes in the entity are related to the primary key, the whole key (in the case of composite keys) and nothing but the key. This is done to prevent the undesirable consequence of modification anomalies. A deletion anomaly exists when, with one deletion, facts are lost about two logical entities. An insertion anomaly exists when data cannot be inserted into a logical entity. Normalization is directed at removing both of these anomalies. For example, suppose we have an entity in our database as depicted in Figure 3-6.

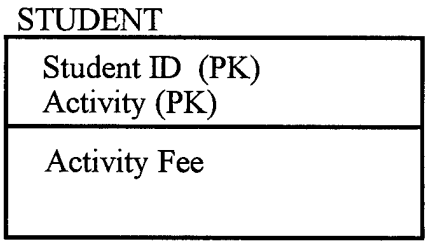


Figure 3-6

Information pertaining to this entity would appear in a table as depicted in Figure 3-7.

Stud ID	Activity	Fee
99	Golf	200
10	Scuba	300
33	Tennis	100
36	Golf	200
14	Golf	200

Figure 3-7

Now suppose that Student 10 drops out of school. If the record for Student 10 is deleted, then we lose not only the fact that Student 10 was enrolled in scuba diving classes, but also the fact that scuba classes cost $300. This is an example of a deletion anomaly.

Imagine that another activity, weightlifting, is offered to students at a fee of $25. That information cannot be entered into the database until a student enrolls in weightlifting. This is an example of an insertion anomaly. The goal of normalization is to remove these anomalies.

Normalization is defined in terms of normalization forms. Commonly understood forms are first through fifth normal forms. For the purposes of this report, it is sufficient to describe only the first through third normal forms.

First Normal Form: A table of data is said to be in first normal form if it meets the definition of a relation. For a table to be a relation, the attributes (cells) in the table must be single valued, and neither repeating groups nor arrays are allowed as values. All entries in a column must be of the same kind. Each column must be uniquely named. Finally, no two rows in the table can be identical. Inspection reveals that the table depicted in Figure 3-7 is in first normal form. Thus, first normal form will not preclude modification anomalies. A table is said to be in first normal form if every attribute is "about the key".

Second Normal Form: Examine Figure 3-7. Again, the primary key consists of both student ID and activity. The problem with this relation that activity fee is dependent upon only part of the composite key. The fee is not dependent upon the student. It is

dependent only upon the activity. The attribute is not dependent upon the whole key. A table is said to be in second normal form if every attribute is "about the whole key".

Third Normal Form: Consider that a student can only take one activity and an activity can only have one fee. Thus, activity is dependent upon student, and fee is dependent upon activity. Put another way, the fee is determined by the activity, and the student's activity is determined by the student's ID. Therefore, it can be said that indirectly, the student's ID determines the fee. This arrangement of dependencies is formally referred to as a transitive dependency. Following this logic, Figure 3-6 could be modified such that only the Student ID is considered to be the primary key. This is illustrated in Figure 3-8.

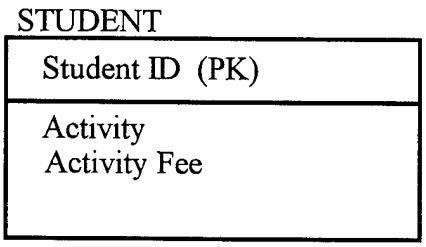


Figure 3-8

In this example, Activity Fee is dependent upon the key, so first normal form is achieved. Activity Fee is also dependent upon the whole key (this should be obvious, as the key is not a composite key). Thus, second normal form is also achieved. Yet modification anomalies can still exist. This is due to the transitive nature of the dependency of fee upon student. Removing transitive dependencies will yield relationships that are in the third normal form. A table is said to be in third normal form if every attribute is "about the key, the whole key, and nothing but the key". In the example shown in Figure 3-8, third normal form is not present, as fee depends not only on the primary key, but also on the activity, which is no longer part of the primary key.

B. Enterprise Data Model for MCI

This section presents the application of the strategy described in section A, as it pertains to the MCI. The focus of this project is the development of a data architecture to support the Student Services Department (SSD) and Management Information Systems (MIS) Department at MCI. However, to facilitate an understanding of the general scope of MCI's future information system needs, the data model section of this report focuses on an enterprise wide data model for MCI. The database design section of a subsequent report will focus exclusively on the SSD and MIS departments.

1. List Candidate Data Entities

The first step in the development of the data architecture for the future MCI client/server based information system was to study the existing databases. This was accomplished by 1) interviewing developers, administrators, and end-users, and 2) studying existing system documentation, screens, and reports. Normally, questionnaires would be used to analyze the database requirements as well. A data collection questionnaire was not used in this project. Questionnaires were not used because of the limited number of database administrators and end-users and their ready availability. However, areas normally addressed in a questionnaire were covered through a series of interviews and site visits.

a. Interviews

Analysis began with the conduct of interviews with developers, programmers, administrators, and users of the current database. Interviews with Mr. Joseph Rudd and Major Donna Gerlaugh were especially valuable, as they are intimately familiar with the structure, functions, nature, modifications, and patches associated with the current flat file system and its related programs. Interviews with the users, especially in SSD, were useful in identifying the underlying purposes of the data, as well as their associated processes and business functions.

Whenever possible, on-site interviews were conducted. On-site interviews (at MCI) afford the opportunity for direct analysis of data, interviewing the largest number of key participants, and allows for a demonstration of the existing system. Additionally, copies of all available documentation are on hand. Follow up communications has been accomplished by scheduling telephonic conferences with Mr. Rudd and Major Gerlaugh, as well as through the exchange of electronic mail.

b. Documentation, Input Screens, and Output Report Review

Information gathered from documentation, user input screens, and output reports has been used to augment the data collected form the developer and user interviews. In the case of MCI, the existing data dictionary is incomplete, poorly documented, and not current. Read ahead material did not reflect current data stores and data definitions in many cases. The output reports provided were of limited use. No systematic analysis of existing output reports was conducted, as no user interviewed placed any importance on the existing reports. The common theme seemed to be that more useful reports were needed, based on statistical analysis not currently conducted.

c. Develop Candidate Entity List

The information gathered through interviews and inspection of documentation was used to develop the candidate entity list for the enterprise wide MCI data model. These entities, at the enterprise wide level, are referred to in this report as ***data subjects.*** The candidate entity list is included as Exhibit 1, Appendix B.

2. Define The Data Subjects and Their Associated Attributes and Relationships

From the list of candidate data subjects, definitions of enterprise wide data subjects were developed. These definitions are shown in Exhibit 2, Appendix B. Primary keys were identified, as shown in Exhibit 3, Appendix B. Candidate attributes were then identified, as illustrated in Exhibit 4, Appendix B. These attributes were then defined as shown in Exhibit 5, Appendix B. Finally, the relationships between the data subjects were identitfied and defined. This is included as Exhibit 6, Appendix B.

3. Develop an Initial Conceptual Data Model

An enterprise wide data model, containing the twenty-six primary subject areas and their relationships, was developed in order to provide a better conceptual understanding of the architecture needs at MCI in terms of development costs, and future hardware, software, and peopleware needs. This enterprise wide, high level data model is included as Exhibit 7, Appendix B.

The detailed SSD model and accompanying data dictionary has been provided to Major Gerlaugh and Mr. Rudd under separate cover, at the time of this report.

The reader should be familiar with the relational database design concepts introduced in section A of this chapter before reading the proposed data model for MCI. ***An understanding of formal database design is crucial for the proper maintenance of MCI's future system.*** In order to maintain the future database, and its accompanying data model, it is necessary that MCI personnel clearly understand the principles of IDEF1X modeling, as well as the underlying theory of relational database design.

ER*win*® or any other suitable CASE tool should be used to facilitate the maintenance of the MCI database. The conceptual database can be reverse engineered using ER*win*® . The CASE tool reads the data dictionary from the specified database management system

(DBMS) or target DBMS server, and uses this information to generate an IDEF1X model and accompanying dictionary. This model can be compared programatically by the CASE tool with the file containing the original data model. This allows for the user to verify the accuracy of the current database, as well as identify changes which have occurred since initial design. Another benefit yielded by such an approach is the ability to rapidly expand and contract the conceptual data model and accompanying database as user requirements change. This makes the data model a living document, with current documentation throughout its life cycle.

Finally, the proposed relational data model for MCI ***requires verification from the database users to ensure its accuracy.***

4. Map Data Subjects to Functions in the Process Model

The enterprise wide data model, containing the twenty-six primary subject areas and their relationships, was used to map entities to functions in the process model. As previously mentioned, these entities are referred to as ***data subjects***, in order to differentiate between them and entities of the same name contained in the detailed IDEF1X model developed for SSD and MIS at MCI.

a. Map Entities to Business Functions

After the initial identification of these data subjects, they were mapped to the functions in the business process model which have been identified by the business process re-engineering team. This mapping was diagrammed in the form of a CRUD matrix.

Before beginning this mapping process, the data subjects were mapped to organizational units, and to physical locations at the MCI. These matrices assisted in the process of mapping data subjects to functions. These matrices are included as a series of exhibits at the end of this chapter.

Matrix	Exhibit #, Appendix B
Data Subjects vs. Organizational Units	Exhibit 8, Appendix B
Data Subjects vs. Physical Locations	Exhibit 9, Appendix B
Data Subjects vs. Functions (CRUD Matrix)	Exhibit 10, Appendix B

b. Refine the Conceptual Data Model

Once the initial mapping of the subject areas to the business functions was complete, the conceptual data model was refined and normalized. This process was only conducted for

those data subjects directly related to the Student Services and MIS Departments, as all others are beyond the scope of this project. Entities were broken down to resolve remaining "many - to - many " relationships, and the desired degree of normalization was achieved. Some degree of de-normalization was accepted. For example, zip codes are not included on a separate table. As previously mentioned, this refined, detailed conceptual model, with its accompanying data dictionary, has been provided to MCI under separate cover at the time of this report.

IV. Preliminary Business Model

This chapter describes the methodology for the development of the clustered Create and Read (CR) Matrix from the CRUD matrix. Clustering the CR matrix graphically illustrates what functions and data subjects fit naturally together, thus revealing the major organization subsystems.

A. Develop a CR Matrix

The CRUD matrix as defined in chapter III maps functions against data subjects (high level entities) arranged in life-cycle order (e.g., a course is first planned, then developed, managed, and finally archived). The CRUD matrix can be further refined and condensed into a "CR matrix" which can be used to identify organization subsystems. To convert a CRUD matrix to a CR matrix, identical function axis and data subject axis are used on a blank matrix but all "C" , "U", "D", and "A" entries from the CRUD diagram are depicted as "C" entries. All "R" entries from the CRUD matrix are depicted as "R" entries on the CR matrix. Exhibit 1, Appendix C is a CR matrix made from the CRUD matrix of chapter III.

B. Cluster to Reveal Organization Subsystems

Using affinity techniques, the "C" intersections are "clustered." Clustering is a technique used to show what functions and data subjects fit naturally together. Clustering rearranges the order of the data subjects so that as you read across the axis, the data subject that is created, updated, deleted, or archived by the first function (reading down the function axis) is moved to the left. Then the data subject created, updated, deleted, or archived by the second function is moved to the left. This continues for all data subjects. The resulting matrix has all the "C's" arranged on a diagonal line running from the top-left to the bottom-right. The data subjects can now be "grouped" into subsystems as shown in Exhibit 2, Appendix C.

The subsystems can now be given names that relate to their commonality. Seven subsystems were identified for MCI: Personnel Administration, Ceremonial Support, Program and Course Management, Program and Course Development, Student Service Support, Warehouse and Distribution, and Information Systems management.

When data use falls outside of any box, the functions inside the box must access the data subject elsewhere, or the data must flow from one subsystem to another. At this point

business activity analysis (BAA) techniques are used to re-engineer the business processes.

C. Document the Preliminary Business Model

This final step serves as the final validation of the enterprise model. See Exhibit 3, Appendix C for the Preliminary Business Model. This diagram and the business function definitions (Exhibit 2, Appendix A) serve as the preliminary business model.

V. Technology Architecture

This chapter discusses the principles that are used as a basis for formulating technology architecture at MCI, overviews baseline and target technology platforms and proposes three options for target architectures with preliminary cost estimates to establish financial planning milestones for system acquisition.

A. Principles for Technology Architecture at MCI

The following principles apply to the formulation of a technology architecture for the Marine Corps Institute project: [Steven Spewak, *Enterprise Architecture Planning*, pg. 226]. These principles will be used to guide the formulation of the technology architecture options in section C.

1. Client/server technology will be used for applications and database implementation.
2. A common graphical user interface will be used by all applications.
3. Data storage will use relational technology, and data access will employ SQL.
4. Apply open system concepts, meaning operating systems should be:
   - **portable** - run across multiple vendor platforms;
   - **scalable** - run across a wide power range from small to large computers;
   - **interoperable** - run in a heterogeneous environment; and
   - **compatible** - preserve the investment in existing software and enable technology advances to be integrated with other components.
5. System development methodology should employ object oriented techniques, information engineering methods, and be supported by CASE and repository tools from requirements analysis through code generation.
6. Data should be captured once at its source.
7. Data should be administered centrally and maintained for shared access.
8. Information that is stored online will be continuously available.

9. Implement distributed data and application systems where possible.
10. Maintain the security of data, software, and hardware assets at all levels of the technology architecture, with security being as transparent as possible.
11. Ensure recoverability to protect the continuation of business by having
    - adequate and appropriate backups of all data;
    - software with built-in error checking and recovery capabilities; and
    - integration and compatibility of hardware with redundancies for critical operations.
12. Adhere to established Marine Corps standards for software.
13. Data storage must be compatible with World Wide Web access requirements.

These principles establish the fundamental guidelines which will govern the development of the technology architecture. By adhering to these principles, the project will incorporate a design which maximizes industry standards and trends, ensures the flexibility of the system for current use, and presents the best possible alternatives for future upgrade.

B. Baseline and Target Technology Platforms

The information included in the technology platform is intended to summarize the requirements for the proposed system. It incorporates existing hardware and software that may be included in proposed designs, as well as new hardware and software that will be required to support proposed designs. The additions to the technology platform are in keeping with the technology principles.

1. Baseline Technology Platforms

The baseline technology is a listing of the platforms currently in use at MCI as of February 1997. It does not include planned upgrades or additions to the on-hand architecture.

Hardware

Minicomputers

HP 3000 series 957SX

Microcomputers (server)
Application servers - pentium
Microcomputers (client)
Pentium - Windows 95 based
486 - Windows 3.11 based
Input Devices
National Computing Systems Scanner-OP7-35
Mouse
Keyboard
Tape drive
Output and graphical displays
HP laser printer
Xerox 4850 line printer
Storage media
CD ROM tower-6 unit RO, 1 unit Write CD

Software

Operating Systems
Windows 95
Windows 3.11
DOS 6.22
HP MPE/ix, ver 5.0
DBMS
HP Turbo Image
Languages
HP Transact
Powerhouse
Quiz
Qdesign
QTP
Other
Lotus Smart Suite
Biscom Fax Service
Source Library System
Plato Courseware
Shark!Mail
Fastran
Edit 3000
Facade
Omnidex

2. Target Technology Platforms

The target technology platform list represents the additional technology platforms under consideration in support of the options contained in this report.

Hardware
- Minicomputers
  - HP 3000 series 987, 987/150, 987/200
  - Series 969/100, 969/200
- Microcomputers (server)
  - Enterprise scale server - Pentium Pro, 200 MHz
  - World Wide Web server-Pentium Pro, 166Mhz
- Microcomputers (client)
  - Pentium - Windows 95 based
  - Pentium - Windows NT based

Software
- Operating Systems
  - Windows 95
  - Windows NT
  - HP MPE/ix, ver 5.5
  - HP/UX
- DBMS
  - Relational DBMS (Oracle Server 7.3)
- Languages
  - Oracle Developer
- Other

Communications
- Networks
  - Operating Systems
    - Windows NT ver 4.0

C. Proposed Architectures

1. Overview

The three options contained in this section present alternatives for technology architectures. All three options adhere, in varying degrees, to the principles established in section A. Regardless of the option chosen, some costs will be the same, others will vary depending on the option chosen. In developing these options, the guidance from MCI to build in seven years of system life was

considered. Training and migration costs are not yet refined to reasonable estimates.

2. Option One - HP Minicomputer Server Running MPE/iX

a. Hardware/Software

This option keeps the existing minicomputer server, while replacing the current database system and application with a relational database system and associated applications. The current server will require some upgrade/replacement of hardware and software to meet growth requirements. The 957SX can be upgraded in incremental steps to model 987/200 which is six times more capable than the existing minicomputer. There are four levels of upgrade available at increasing increments of cost. The two microcomputer purchase initiatives currently underway will satisfy client workstation requirements. (See Exhibit 1, Appendix D)

b. Migration Issues

The ability to use the existing hardware and operating system (MPE/ix) will enable more incremental transition for the MIS personnel at MCI. By adding the relational database to existing hardware and operating system, the MIS personnel will be able to focus training strategies on the transition to a new database management system, without simultaneously having to learn new hardware and operating systems.

The input data (MCTFS) for the new database is currently available on the HP 3000. Since the current server and operating system are used for the new environment, the proposed action will allow for a smoother migration. The new database will be installed on the same server as the existing one, thus greatly simplifying the migration. Full details on migration issues and costs are currently being developed.

c. Development Issues

Development costs for this option will include three microcomputers, application development software, support for this software and compensation for the developers. A general planning figure for the compensation should be based on six developers for six months. Additionally, training for MIS personnel in development tools and DBMS will be required.

The following is a summary of the pros and cons of this option.

Pros:

1. Current personnel trained on HP 3000 hardware and MPE/ix operating system
2. Support system already in place for HP products
3. POSIX compliant operating system
4. Potentially simplified migration

Cons:

1. MPE/ix is not DoD or USMC standard
2. MPE/ix is not a truly open system
3. High yearly maintenance costs
4. High upgrade costs

3. Option Two - HP Minicomputer Server Running UNIX (HP/UX)

a. Hardware/Software

This option requires a change to both hardware and operating systems. The HP 3000 would be replaced with an HP 969/200 as the base hardware for implementation, and the operating system would be HP/UX, which is the HP version of the UNIX operating system. The HP 969/200 is the next generation of HP minicomputers and is indexed at 7 times more capable than the current system.

This option will establish a relational database on the new minicomputer, replacing the current database system and related applications. This database server will be capable of meeting the business needs of the SSD for the required growth cycle (7 years). The two microcomputer purchase initiatives currently underway will satisfy client workstation requirements. (See Exhibit 2, Appendix D)

b. Migration Issues

This option is more complex than option one, but less complex than option three. It will require extensive training of MIS personnel in UNIX and is likely to increase the complexity of the transition. Entry MIS personnel have some UNIX exposure, and UNIX is an open system widely used in industry and DoD. In addition, Oracle support and experience with UNIX platforms is the most developed. The likelihood of simplified interface with developing technologies for future applications and equipment is improved with the UNIX O/S. HP personnel will be available for hardware migration assistance to facilitate the cut over from one platform to the other. This solution has greater risk than option one.

c. Development Issues

Development costs for this option will be the same as option one and include three microcomputers, application development software, support for this software and compensation for the developers. A general planning figure for the compensation should be based on six developers for six months. Additionally, training for MIS personnel in development tools and DBMS will be required.

The following is a summary of the pros and cons of this option.

Pros:

1. More open and more standard operating system
2. UNIX O/S is preferred platform by Oracle
3. UNIX O/S provides better World Wide Web interface and design
4. UNIX O/S simplifies external services (print gateway)

Cons:

1. Significant learning curve for senior MIS personnel
2. Option two will complicate migration by requiring new hardware and software for transition period
3. UNIX security weaknesses
4. High yearly maintenance costs

4. Option Three - Intel Based Server Running NT

a. Hardware/Software

This option establishes a relational database on a new Intel based server, capable of meeting the current and future business needs of MCI. It includes a replacement/upgrade of existing workstations with new equipment (increased memory), and an entire O/S migration from existing software. It would standardize the O/S for the database server, LAN servers, and all work stations to Windows NT. The client microcomputers for SSD (and any other users) must be 32 bit systems, pentium processors, with a minimum of 16 MB memory and 1 GB storage. They must be configured for network access and provide access to electronic mail, business suite applications, the relational database, message system software, World Wide Web access, and customer service/help desk applications. (See Exhibit 3, Appendix D)

b. Migration Issues

In migrating from the current environment, this option is the most problematic. It will require MIS personnel to learn a new O/S, new hardware, new applications, and a new DBMS simultaneously. It will be the most difficult migration implementation and might require the development of a sophisticated gateway for transition from MPE/ix Turbo Image to a Windows NT based version of Oracle 7.3.

This option does embrace state-of-the-art technology and will place MCI in the mainstream of technological implementation. There is significant likelihood that the USMC is transitioning to NT as a server O/S, and this would position MCI to have an O/S that was standard compliant and enterprise wide (mail server, web server, file server, database server all on the same O/S). In addition, adopting a single O/S across client and server would simplify middleware issues for the system.

c. Development Issues

Development costs for this option will be the same as option one and two and include three microcomputers, application development software, support for this software and compensation for the developers. A general planning figure for the compensation should be based on six developers for six months. Additionally, training for MIS personnel in development tools and DBMS will be required.

The following is a summary of the pros and cons of this option.

Pros:

1. Oracle corporate interest in NT developments
2. Position for standardized operating systems
3. Current direction of industry
4. Newest technology
5. Hardware costs are comparatively low

Cons:

1. Very steep learning curve for MIS personnel
2. Significantly more complicated migration
3. Client/server middleware reliability issues
4. Many more variables-highest risk

5. Recommendations

A major guideline in recommending an option for implementation is its likelihood of success/risk of failure. While option three represents state-of-the-art architecture, and is therefore the best for long term success, the feasibility of adopting and implementing it immediately is in question due to the high cost of training and migration.

It is therefore recommended that MCI adopt a phased approach to upgrade the current technology platform. The first phase is option one, and it consists of upgrading the current HP 3000 minicomputer and using it as a server, installing a new Oracle DBMS under the current MPE/iX operating system, and replacing the current dumb terminals with client pentium level microcomputers. The second phase (option three) incrementally migrates to a true open system architecture and consists of an Intel-based server, Windows NT operating system, Oracle DBMS, and state-of-the-art microcomputer clients.

VI. Conclusion

This chapter summarizes the findings of this preliminary report.

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1. The enterprise level business functions require very little reorganization. Several business functions were identified that could benefit from automation.

2. The data modeling methodology outlined in this report was validated and revealed that a relational database could be developed to support the MCI student services department function.

3. The relational database will allow information to be shared between student services department functions, facilitate automation, eliminate data redundancy, and improve customer service.

4. Three technology architecture options were identified. These are available for the implementation of the client/server open architecture system and underlying relational database.

5. All three architectures (business/process, data and technology) are extremely important for successful redesign at both enterprise and business application area levels.

6. The enterprise wide model revealed eight subsystems in the clustered CR diagram.

7. Enterprise wide re-engineering at MCI requires the level of analysis that the student services department will receive during the remainder of this project.

8. A single relational database can be developed to support all eight subsystems.

9. With regard to the student services division redesign project, migration planning will be a challenging endeavor, worthy of further investigation. In order for a successful migration to occur, the implementation team must be well trained in the chosen tools and allowed to interface with the redesign team from the Naval Postgraduate School.

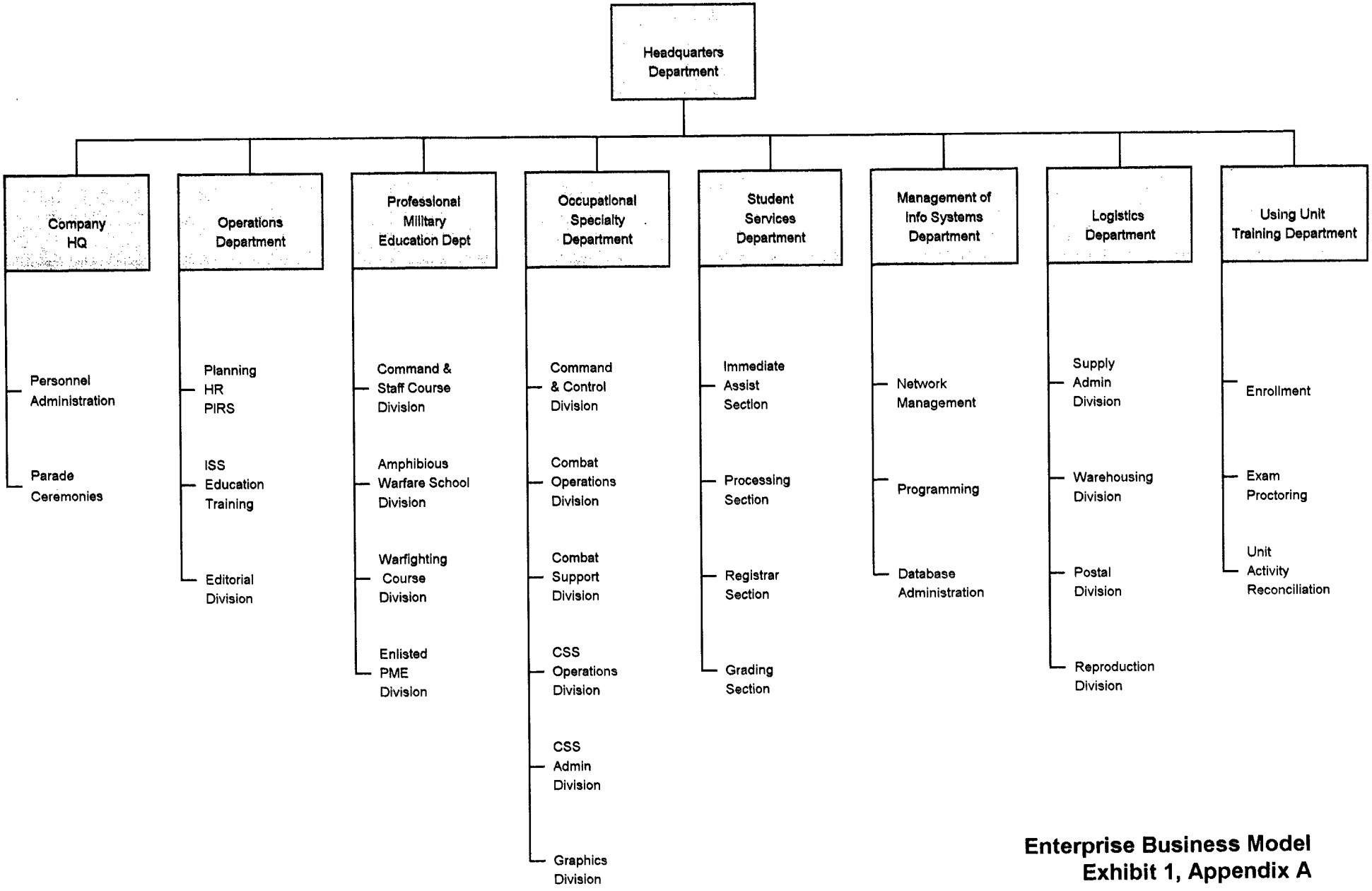
Appendix A.
Enterprise Business Model Exhibits

Appendix B.
Enterprise Data Model Exhibits

Appendix C.
Preliminary Business Model Exhibits

Appendix D.
Technology Architecture Exhibits

MCI Organizational Chart



Enterprise Business Model
Exhibit 1, Appendix A

Business Function Definitions

Function Name	Function Definition
ADVERTISING	To publish or announce Programs, Courses and Job Aids in the MCI Course Catalog, military newspapers, ALMARs, MARINE magazine, etc.
ANALYSIS OF EFFECTIVENESS	To collect and analyze data from returned exams and track answer selection in order to revise exam questions or Program/Course text.
BUDGETING	To manage budget categories for developing, producing and distributing MCI Programs, Courses and Job Aids.
COURSE DESIGN	To identify & establish the design specifications, schedule and prerequisites for MOS Courses and Job Aids to meet Marine Corps training and education requirements for target audience.
COURSE REVISING	To revise Job Aids and MOS Course text, examinations and related material based on feedback from students, Course sponsors, CG, MCCDC and internal analysis of effectiveness.
COURSE STAFFING	To allow a newly designed MOS Courses and Job Aids to be reviewed by all of the agencies and departments responsible for its production (e.g., text writing, graphics, editing, production, advertising, purchasing, etc.) and distribution.
COURSE WRITING	To research and write the MOS Course text, components, examinations and Job Aids.
CUSTOMER SERVICING	To respond to customer inquiries of any nature (as it relates to the MCIAIS) and process customer requests for MCI action (enrollment, material request, update information, etc.). This service supports inquiries received by telephone, electronic mail, U.S. Mail, or over the counter.
DATABASE ADMINISTRATION	To download and upload TFS and unit diary information into the MCIAIS; to upload and service the automated telephone Conversant system database. To commit daily transaction files; to troubleshoot database or related problems; to backup database.
DELIVERING	To deliver Program materials, Course materials, Job Aids, Diplomas, Course Completions certification and course components to students.
DISPOSING	To purge warehouse of obsolete Program and Course materials, Job Aids and course components.
EDITING	To review new and revised Programs, Courses and Job Aids for Instructional System content and quality.
EXAM PROCTORING	Monitoring examinations to Marines in the fleet to ensure compliance with the MCI Procedures Manual.
GRADING	To record the scores of examinations, in the MCI student database, graded by both automated & manually means.

Business Function Definitions

Function Name	Function Definition
INVENTORY	To manage on-hand quantities and locations of on-hand material.
LAYOUT & GRAPHICS	To create new graphics, improve existing graphics, and maintain library of appropriate graphics and artwork for Program text, Course text, and Job Aids.
MANAGE NETWORKS	To install, manage and maintain telephone and data network equipment.
ORDERING	To requisition Program and Course materials, Job Aids and course components distributed by MCI.
PACKAGING	To assemble and shrink wrap Program and Course materials, Job Aids and course components for distribution and storage.
PARADE SUPPORT	To coordinate MCI personnel to support the ceremonial activities at the Marine Barracks.
PLANNING	To schedule and coordinate all planning associated with MCI Parades and Ceremonial Details involving MCI personnel.
PROGRAM DESIGN	To identify and establish the design specifications, schedule and prerequisites for PME courses to meet Marine Corps training and education requirements for target audience.
PROGRAM REVISING	To revise PME Program text, examination and related material subject to feedback from students, Program sponsors, CG, MCCDC, and internal analysis of effectiveness.
PROGRAM STAFFING	To allow a newly designed or revised PME Program content to be reviewed by all of the agencies and departments responsible for its production (e.g., text writing, graphics, editing, production, advertising, purchasing, etc.) and distribution.
PROGRAM WRITING	To research and write the PME Program text, components and examinations.
PROGRAMMING	To write program source code that corrects or enhances database administration.
RECEIVING	To receipt for materials that will be stored in the warehouse.
REGISTRAR SERVICING	To research and produce diplomas, completion certificates and transcripts for students.
REPRODUCTION SERVICING	To prepare negatives, camera-ready originals, and print specifications for contract orders to commercial printers, maintain negatives and camera-ready copy for MCI courses; to reproduce/print original documents for MCI or Marine Barracks in quantities less than 25,000.

Business Function Definitions

Function Name	Function Definition
STORING	To stock (on location in the warehouse) received materials.
STUDENT ACTIVITY TRANSACTIONS	To manage student records and monitor the transaction processing sytem.
TRAINING	To coordinate training of MCI course writers and programmers.
UNIT RECONCILING	To provide MCI with feedback from units so MCIAIS can be validated and updated if required.

Organizational Unit vs Location

Organizational Unit \ Location	MCI Building 1st Floor	MCI Building 2nd Floor	Marine Barracks	MCI Warehouse	Using Unit
Headquarters		*	*		
Training & Operations Department	*				
Professional Military Education Department		*			
Occupational Specialty Department	*				
Student Services Department		*			
Management Information Systems Department		*			
Logistics Department				*	
Unit Training Representative					*

Updated: 13 Feb 97

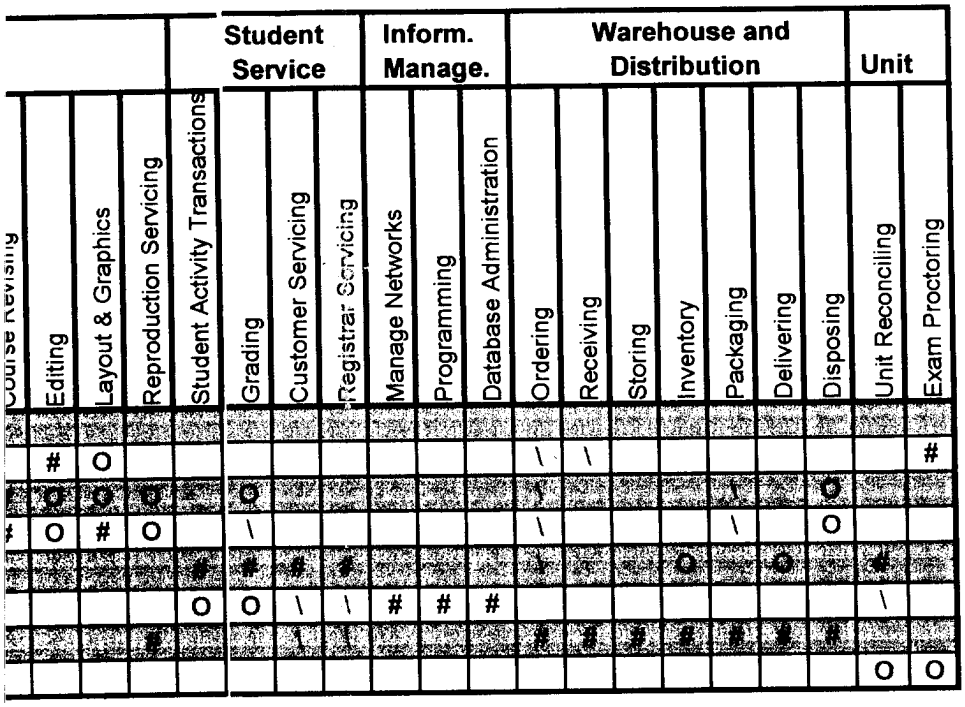
Organizational Unit vs Fu

Function / Organizational Unit	HQ Support			Course Management				Course Development										Student Service			
	Personnel Administration	Parade	Planning	Budgeting	Training	Advertising	Analysis of Effectiveness	Program Design	Program Writing	Program Staffing	Program Revising	Course Design	Course Writing	Course Staffing	Course Revising	Editing	Layout & Graphics	Reproduction Servicing	Student Activity Transactions	Grading	Customer Servicing	Registrar Servicing
Headquarters	#	O	O	O																	
Training and Ops Dept	\	#	#	#	#	#	#	O				O				#	O					
Prof Military Educ Dept																				O		
Occupational Specialty Dept	\	\		\	\	\	\					#	#	#	#	O	#	O		\		
Student Services Dept																			#	#	#	#
Mgmt Info Systems Dept	\	\		O	\														O	O	\	\
Logistics Department				O																		
Unit Training Representative																						

Updated: 17 Feb 97

Symbols
- Major responsibility and decision maker
O - Major involvement in the function
\ - Some involvement in the process

ganizational Unit vs Function



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ion
ess

Enterprise Business Model
Exhibit 4, Appendix A

Location vs Function

Function / Location	HQ Support			Course Management				Course Development										Student Service				Inform. Manage.			Warehouse and Distribution							Unit	
	Personnel Administration	Parade	Planning	Budgeting	Training	Advertising	Analysis of Effectiveness	Program Design	Program Writing	Program Staffing	Program Revising	Course Design	Course Writing	Course Staffing	Course Revising	Editing	Layout & Graphics	Reproduction Servicing	Student Activity Transactions	Grading	Customer Servicing	Registrar Servicing	Manage Networks	Programming	Database Administration	Ordering	Receiving	Storing	Inventory	Packaging	Delivering	Disposing	Unit Reconciling	Exam Proctoring
MCI Building 1st Floor	*	*	*	*	*	*	*					*	*	*	*	*	*																
MCI Building 2nd Floor		*	*	*	*			*	*	*	*	*	*	*	*	*			*	*	*	*	*	*	*								
Marine Barracks	*	*	*																				*										
MCI Warehouse		*		*														*								*	*	*	*	*	*	*		
Using Unit																																	*	*

Updated: 18 Feb 97

Enterprise Business Model
Exhibit 5, Appendix A

Appendix B.
Enterprise Data Model Exhibits

Candidate Data Subject Report
Lists Candidate Data Subjects
02/25/97 8:47 PM
Maj. Slaughter

Data Subject Name
ADVERTISMENT
COMPONENTS
COPY_MATERIAL
COURSE
COURSE_COPY_MATERIAL
COURSE_DEVELOPERS
CUSTOMER
EVENTS
EXAM
FINANCIAL
INVENTORY
IS_EQUIPMENT_INVENTORY
ISSUE_COMPLAINT
JOB_AID
JOB_AID_COPY_MATERIAL
MCI_PERSONNEL
MCTF_PERS
ORDER
PROGRAM
PROGRAM_COPY_MATERIAL
PROGRAM_DEVELOPERS
PURCHASE
SSD_PERSONNEL
STUDENT
TRAINING
WAREHOUSE

Data Subject Definition Report
Lists Data Subjects and Their Definitions
02/25/97 8:53 PM
Maj. Slaughter

Data Subject Name	Data Subject Definition
ADVERTISMENT	Contains information on advertising projects. Advertising projects are related to courses and programs
COMPONENTS	Table of all items stocked by MCI. This includes items included in courses and programs(lessons, course material, dictionaries, etc.) as well as items included in job-aids (FAC manuals, etc.)
COPY_MATERIAL	Copy Material is any text or graphic material which must be written or produced by a developer or writer. It is stored electronically as binary data for future reproduction or distribution as either digital or paper material. It includes such things as exams, course material, program books and material, etc. Due to the size of some material, it may be stored on some backup storage media. If this is the case, this record will only contain a pointer to indicate the location of the material. Smaller material may be stored directly in the database.
COURSE	All active, closed, and future courses as entered by the course developer.
COURSE_COPY_MATERIAL	copy material which is associated with a course
COURSE_DEVELOPERS	MCI Course developers and writers
CUSTOMER	Anyone who contacts MCI with a question. Contact may be by telephone, e-mail, in person, regular mail, etc.
EVENTS	Parade and VIP events staffed or supported by MCI
EXAM	An instance of a specific exam as generated for a specific course
FINANCIAL	Contains budgeting information. Certain line items may be associated with the funding designated for the development of courses and programs
INVENTORY	An inventory record for a component
IS_EQUIPMENT_INVENTORY	Contains the inventory records of all IS Equipment
ISSUE_COMPLAINT	A customer generates an issue or a complaint
JOB_AID	Table of all job aids stocked by MCI.
JOB_AID_COPY_MATERIAL	Copy material which is associated with a job aid
MCI_PERSONNEL	All personnel employeed at MCI
MCTF_PERS	Table of all MCTF personnel as downloaded from the Total Force database
ORDER	An order is any request by a customer for components, job aids, courses, or programs other than an actual enrollment in a course or program
PROGRAM	All active, closed, and future programs as entered by the program developer.
PROGRAM_COPY_MATERIAL	Copy material which is associated with a program
PROGRAM_DEVELOPERS	MCI Program developers and Writers
PURCHASE	All course components are purchased. An order is placed by a MCI clerk and filled by a supplier.
SSD_PERSONNEL	Personnel working in the Student Services Department
STUDENT	All Students contained in the MCI database
TRAINING	Training programs for MCI course writers and programmers are described here.
WAREHOUSE	A warehouse is not just the main warehouse or warehouses belonging to logistics. As any department may potentially store material, there may be one or more warehouses associated with each department

Entity Relationship Report
Lists Entities, Primary Keys, Foreign Keys, and Relationships
02/25/97 8:50 PM
Maj. Slaughter

Entity Name	Entity Type	Primary Key	Foreign Keys	Parent In Relationships
ADVERTISMENT	Independent	Project_ID		
COMPONENTS	Independent	Comp_ID		COMPONENTS are tracked by INVENTORY Cardinality: One-to-Zero-One-or-More
				COMPONENTS is part of COURSE Cardinality: Many-to-Many
				COMPONENTS is part of EXAM Cardinality: Many-to-Many
				COMPONENTS is part of JOB_AID Cardinality: Many-to-Many
				COMPONENTS is part of PROGRAM Cardinality: Many-to-Many
				COMPONENTS may be composed of COPY_MATERIAL Cardinality: One-to-Zero-One-or-More
COPY_MATERIAL	Dependent	Comp_ID Material_ID	Component_ID References: COMPONENTS	JOB_AID_COPY_MATERIAL + COURSE_COPY_MATERIAL + PROGRAM_COPY_MATERIAL are subcategories of COPY_MATERIAL
COURSE	Independent	Crs_ID		COURSE has EXAM Cardinality: One-to-Zero-One-or-More
				COURSE has many STUDENT Cardinality: Many-to-Many
				COURSE is associated with ADVERTISMENT Cardinality: Many-to-Many
				COURSE is funded by FINANCIAL Cardinality: Zero-or-One-to-Zero-One-or-More
COURSE_COPY_MATERIAL	Dependent	Comp_ID Material_ID	Material_ID, Component_ID References: COPY_MATERIAL	
COURSE_DEVELOPERS	Dependent	SSN_ID	SSN_ID References: MCI_PERSONNEL	COURSE_DEVELOPERS develops COMPONENTS Cardinality: Many-to-Many
				COURSE_DEVELOPERS develops COURSE Cardinality: Many-to-Many
				COURSE_DEVELOPERS develops JOB_AID Cardinality: Many-to-Many

Enterprise Data Model
Exhibit 3, Appendix B

Entity Relationship Report
Lists Entities, Primary Keys, Foreign Keys, and Relationships
02/25/97 8:50 PM
Maj. Slaughter

Entity Name	Entity Type	Primary Key	Foreign Keys	Parent In Relationships
CUSTOMER	Independent	CustSSN_ID		CUSTOMER generates a ISSUE_COMPLAINT Cardinality: One-to-Zero-One-or-More
				CUSTOMER places an ORDER Cardinality: One-to-Zero-One-or-More
EVENTS	Independent	Event_ID		
EXAM	Dependent	Crs_ID Exam_ID	Course_ID References: COURSE	
FINANCIAL	Independent	LineItem Year	Course_ID References: COURSE Program_ID References: PROGRAM	
INVENTORY	Dependent	Comp_ID Warehouse_ID	Component_ID COMPONENTS Warehouse_ID References: WAREHOUSE	
IS_EQUIPMENT_INVENTORY	Independent	Serial_No		
ISSUE_COMPLAINT	Dependent	CustSSN_ID IssueNumber	CustomerSSN_ID References: CUSTOMER	
JOB_AID	Independent	JobAid_ID		JOB_AID is part of COURSE Cardinality: Many-to-Many
JOB_AID_COPY_MATERIAL	Dependent	Comp_ID Material_ID	Material_ID, Component_ID References: COPY_MATERIAL	
MCI_PERSONNEL	Independent	SSN_ID	MCTFSSN_ID References: MCTF_PERS	SSD_PERSONNEL + COURSE_DEVELOPERS + PROGRAM_DEVELOPERS are subcategories of MCI_PERSONNEL
				MCI_PERSONNEL has many EVENTS Cardinality: Many-to-Many
MCTF_PERS	Independent	MCTFSSN		MCTF_PERS may be a MCI_PERSONNEL Cardinality: Zero-or-One-to-Exactly-1

Enterprise Data Model
Exhibit 3, Appendix B

Entity Relationship Report
Lists Entities, Primary Keys, Foreign Keys, and Relationships
02/25/97 8:50 PM
Maj. Slaughter

Entity Name	Entity Type	Primary Key	Foreign Keys	Parent In Relationships
				MCTF_PERS may be a STUDENT Cardinality: Zero-or-One-to-Exactly-1
ORDER	Dependent	CustSSN_ID InvoiceNumber	CustomerSSN_ID References: CUSTOMER	ORDER is comprised of COMPONENTS Cardinality: Many-to-Many
				ORDER is comprised of COURSE Cardinality: Many-to-Many
				ORDER is comprised of JOB_AID Cardinality: Many-to-Many
				ORDER is comprised of PROGRAM Cardinality: Many-to-Many
PROGRAM	Independent	Program_ID		PROGRAM has many STUDENT Cardinality: Many-to-Many
				PROGRAM is associated with ADVERTISMENT Cardinality: Many-to-Many
				PROGRAM is funded by FINANCIAL Cardinality: Zero-or-One-to-Zero-One-or-More
				PROGRAM is part of COURSE Cardinality: Many-to-Many
PROGRAM_COPY_MATERIAL	Dependent	Comp_ID Material_ID	Material_ID, Component_ID References: COPY_MATERIAL	
PROGRAM_DEVELOPERS	Dependent	SSN_ID	SSN_ID References: MCI_PERSONNEL	PROGRAM_DEVELOPERS develops COMPONENTS Cardinality: Many-to-Many
				PROGRAM_DEVELOPERS develops COURSE Cardinality: Many-to-Many
				PROGRAM_DEVELOPERS develops PROGRAM Cardinality: Many-to-Many
PURCHASE	Independent	Order_ID		PURCHASE is for COMPONENTS Cardinality: Many-to-Many
SSD_PERSONNEL	Dependent	SSN_ID	SSN_ID References: MCI_PERSONNEL	SSD_PERSONNEL resolves an ISSUE_COMPLAINT Cardinality: Many-to-Many
STUDENT	Independent	StudSSN_ID	MCTFSSN_ID	

Entity Relationship Report
Lists Entities, Primary Keys, Foreign Keys, and Relationships
02/25/97 8:50 PM
Maj. Slaughter

Entity Name	Entity Type	Primary Key	Foreign Keys	Parent In Relationships
			References: MCTF_PERS	
TRAINING	Independent	TrainingProg_ID		TRAINING relates to MCI_PERSONNEL Cardinality: Many-to-Many
WAREHOUSE	Independent	Warehouse_ID		WAREHOUSE contain INVENTORY Cardinality: One-to-Zero-One-or-More

Candidate Attribute Report
List of Candidate Data Attributes
02/25/97 8:51 PM
Maj. Slaughter

Base Name
Addr1
Addr2
BldgNumber
BudgetAmount
City
Comments
CommercialNo
Component
ComponentDescription
ComponentName
Component_ID
CopyMaterial
CourseAbbreviation
CourseNumber
Course_ID
CreditHours
Custodian
CustomerSSN_ID
DCTB
DSNNumber
Date
DateClosed
DateOpened
Department
Description
DesignedFor
ECC
ECC
EDD
EventCoordinator
EventDate
EventDesc
EventLocation
EventName
EventTime
Event_ID
Exam_ID
FirstName
Grade
InvoiceNumber
IssueNumber
JobAidDescription
JobAidName
JobAid_ID
JobDescription
LastName
LineItem
Location

Candidate Attribute Report
List of Candidate Data Attributes
02/25/97 8:51 PM
Maj. Slaughter

Base Name
MCTFSSN_ID
MOS
Manager
Material_ID
MiddleInitial
Nomenclature
NumberOfQuestions
OccFieldSpec
OnHand
OrdStatDate
OrderDate
Order_ID
PDD
PassingScore
Phone
PlatoonCode
Pointer
ProgramAbbreviation
Program_ID
Project_ID
Quantity
RDD
Rank
ReserveCredits
SSN_ID
SalesRep
SchoolCode
Section
SelToGrade
Serial_No
State
StudyHours
Supplier
Title
TrainingProg_ID
Warehouse_ID
Year
ZipCode

Attribute Definition Report
Lists Attributes and Their Definitions for All Data Subjects
02/25/97 8:48 PM
Maj. Slaughter

Attribute Name	Entity Header	Attribute Definition	Column Datatype	Null Option
Addr1	CUSTOMER	First line of customer's address	VARCHAR2(46)	NOT NULL
Addr1	MCTF_PERS	First address line of the Home Address for a Marine contained in the MCTFS database. Used as the mailing Address for Reservists	VARCHAR2(46)	NOT NULL
Addr1	STUDENT	First line of student's mailing address	VARCHAR2(46)	NULL
Addr2	CUSTOMER	Second line of customer's address	VARCHAR2(46)	NULL
Addr2	MCTF_PERS	Second Address line of the Home Address for a Marine contained in the MCTFS database. Used as the mailing Address for Reservists	CHAR(46)	NULL
Addr2	STUDENT	Second line of student's mailing address	VARCHAR2(46)	NULL
BldgNumber	WAREHOUSE	Building number of the warehouse	VARCHAR2(3)	NOT NULL
BudgetAmount	FINANCIAL	Amount budgeted	NUMBER	NOT NULL
City	CUSTOMER	City of customer's address	VARCHAR2(34)	NOT NULL
City	MCTF_PERS	City of the Home Address for a Marine contained in the MCTFS database. Used as the mailing Address for Reservists	VARCHAR2(34)	NULL
City	STUDENT	City of student's mailing address	VARCHAR2(34)	NULL
Comments	ISSUE_COMPLAINT	comments regarding the complaint or issue	VARCHAR2(2000)	NOT NULL

Attribute Name	Entity Header	Attribute Definition	Column Datatype	Null Option
Comments	PURCHASE	Any comments associated with the order. Add for clarity.	VARCHAR2(2000)	NULL
CommercialNo	CUSTOMER	Commercial telephone number where customer can be reached	CHAR(10)	NULL
Component	MCTF_PERS	Component of a Marine contained in the MCTFS database.	CHAR(2)	NOT NULL
ComponentDescription	COMPONENTS	Narrative description of each item	VARCHAR2(60)	NOT NULL
ComponentName	COMPONENTS	Name associated with each component as provided by the LOGAIS system.	VARCHAR2(30)	NOT NULL
Component_ID	COMPONENTS	Unique ID associated with every component. Ideally, these values will be provided and updated via interface with LOGAIS inventory software.	VARCHAR2(10)	NOT NULL
Component_ID	COPY_MATERIAL	Unique ID associated with every component. Ideally, these values will be provided and updated via interface with LOGAIS inventory software.	VARCHAR2(10)	NOT NULL
Component_ID	COURSE_COPY_MATERIAL	Unique ID associated with every component. Ideally, these values will be provided and updated via interface with LOGAIS inventory software.	VARCHAR2(10)	NOT NULL
Component_ID	INVENTORY	Unique ID associated with every component. Ideally,	VARCHAR2(10)	NOT NULL

Attribute Name	Entity Header	Attribute Definition	Column Datatype	Null Option
		these values will be provided and updated via interface with LOGAIS inventory software.		
Component_ID	JOB_AID_COPY_MATERIAL	Unique ID associated with every component. Ideally, these values will be provided and updated via interface with LOGAIS inventory software.	VARCHAR2(10)	NOT NULL
Component_ID	PROGRAM_COPY_MATERIAL	Unique ID associated with every component. Ideally, these values will be provided and updated via interface with LOGAIS inventory software.	VARCHAR2(10)	NOT NULL
CopyMaterial	COPY_MATERIAL	a binary object. The actual material. This could be an image, a course text, etc.	LONG	NULL
CourseAbbreviation	COURSE	Course Abbreviation as used for MMS updates	VARCHAR2(20)	NOT NULL
CourseNumber	COURSE	Course number with NO version	VARCHAR2(4)	NOT NULL
Course_ID	COURSE	Course number with version number if applicable	VARCHAR2(6)	NOT NULL
Course_ID	COURSE_COPY_MATERIAL	course number associated with this material	VARCHAR2(6)	NOT NULL
Course_ID	EXAM	Course number with version number if applicable	VARCHAR2(6)	NOT NULL
Course_ID	FINANCIAL	Course number with version number if applicable	VARCHAR2(6)	NULL
CreditHours	COURSE	Credit Hours associated with the Course for transcript generation	VARCHAR2(3)	NULL

Attribute Name	Entity Header	Attribute Definition	Column Datatype	Null Option
		purposes. Must contain a value if course is accredited.		
CreditHours	PROGRAM	Credit hours associated with the program. Must contain a value if program is accredited. Used for transcript purposes.	VARCHAR2(3)	NULL
Custodian	IS_EQUIPMENT_INVENTORY	Individual responsible for equipment	VARCHAR2(30)	NOT NULL
CustomerSSN_ID	CUSTOMER	Social Security Number of each customer being served by SSD via hotline, email, regular mail, or in person.	CHAR(9)	NOT NULL
CustomerSSN_ID	ISSUE_COMPLAINT	Social Security Number of each customer being served by SSD via hotline, email, regular mail, or in person.	CHAR(9)	NOT NULL
CustomerSSN_ID	ORDER	Social Security Number of each customer being served by SSD via hotline, email, regular mail, or in person.	CHAR(9)	NOT NULL
DCTB	MCI_PERSONNEL	Date current tour at MCI began	DATE	NOT NULL
DSNNumber	CUSTOMER	DSN telephone number where customer can be reached	CHARACTER(7)	NULL
Date	ISSUE_COMPLAINT	Date of the complaint or issue	DATE	NOT NULL
Date	ORDER	Date of the order	DATE	NOT NULL
DateClosed	COURSE	Date course closed, if any.	DATE	NULL
DateClosed	EXAM	Date this version of the exam was closed.	DATE	NULL

Attribute Definition Report
Lists Attributes and Their Definitions for All Data Subjects
02/25/97 8:48 PM
Maj. Slaughter

Attribute Name	Entity Header	Attribute Definition	Column Datatype	Null Option
DateClosed	PROGRAM	Date program closed for enrollment	DATE	NULL
DateOpened	COURSE	Date course opened for enrollment	DATE	NULL
DateOpened	EXAM	Date this version of the exam was opened.	DATE	NULL
DateOpened	PROGRAM	Date program opened for enrollment	DATE	NULL
Department	FINANCIAL	department associated with line item	VARCHAR2(40)	NOT NULL
Department	MCI_PERSONNEL	MCI department	VARCHAR2(20)	NOT NULL
Department	WAREHOUSE	Department owning the warehouse	VARCHAR2(6)	NOT NULL
Description	ADVERTISMENT	a description of the advertising project	VARCHAR2(2000)	NOT NULL
Description	COURSE	Course description as provided in the MCI course catalog	LONG	NULL
Description	FINANCIAL	Description of line item	VARCHAR2(2000)	NOT NULL
Description	IS_EQUIPMENT_INVENTORY	Description of equipment item	VARCHAR2(200)	NOT NULL
Description	ISSUE_COMPLAINT	Description of the complaint or issue	VARCHAR2(400)	NOT NULL
Description	TRAINING	a description of the training program	VARCHAR2(2000)	NOT NULL
DesignedFor	COURSE	Personnel for whom course is designed, as provided in the MCI course catalog.	VARCHAR2(200)	NULL
ECC	MCI_PERSONNEL	End of current Contract	DATE	NULL
ECC	MCTF_PERS	End of Current Contract of a Marine contained in the MCTFS database.	DATE	NULL
EDD	PURCHASE	expected delivery date	DATE	NOT NULL

Attribute Definition Report
Lists Attributes and Their Definitions for All Data Subjects
02/25/97 8:48 PM
Maj. Slaughter

Attribute Name	Entity Header	Attribute Definition	Column Datatype	Null Option
EventCoordinator	EVENTS	Coordinator of the Event	VARCHAR2(20)	NOT NULL
EventDate	EVENTS	Date of the Event	DATE	NOT NULL
EventDesc	EVENTS	Description of the Event	VARCHAR2(2000)	NOT NULL
EventLocation	EVENTS	Location of event	VARCHAR2(50)	NOT NULL
EventName	EVENTS	Name of the Event	VARCHAR2(100)	NOT NULL
EventTime	EVENTS	Time of the Event	VARCHAR2(6)	NOT NULL
Event_ID	EVENTS	Unique Number identifying the event	NUMBER	NOT NULL
Exam_ID	EXAM	Exam number generated by the system, unique to each exam version for a specified course.	NUMBER	NOT NULL
FirstName	CUSTOMER	First Name of Customer	VARCHAR(10)	NOT NULL
FirstName	MCI_PERSONNEL	First Name	VARCHAR2(10)	NOT NULL
FirstName	MCTF_PERS	First Name of a Marine contained in the MCTFS database.	VARCHAR2(10)	NOT NULL
FirstName	STUDENT	Student's first name	VARCHAR2(10)	NOT NULL
Grade	MCTF_PERS	Grade of a Marine contained in the MCTFS database.	CHAR(2)	NOT NULL
InvoiceNumber	ORDER	Number which identifies an invoice	NUMBER	NOT NULL
IssueNumber	ISSUE_COMPLAINT	Unique number identifying the complaint or issue	NUMBER	NOT NULL
JobAidDescription	JOB_AID	Narrative description of each item	VARCHAR2(600)	NOT NULL
JobAidName	JOB_AID	Name associated with each job aid as provided by the LOGAIS system.	VARCHAR2(30)	NOT NULL
JobAid_ID	JOB_AID	Unique ID associated with every job aid. Ideally, these values will be provided and	VARCHAR2(10)	NOT NULL

Attribute Name	Entity Header	Attribute Definition	Column Datatype	Null Option
		updated via interface with LOGAIS inventory software.		
JobAid_ID	JOB_AID_COPY_MATERIAL	job aid associated with this material	VARCHAR2(10)	NOT NULL
JobDescription	MCI_PERSONNEL	Job Description	VARCHAR2(2000)	NULL
LastName	CUSTOMER	Last name of customer	VARCHAR2(20)	NOT NULL
LastName	MCI_PERSONNEL	Last name	VARCHAR2(20)	NOT NULL
LastName	MCTF_PERS	Last Name of a Marine contained in the MCTFS database.	VARCHAR2(20)	NOT NULL
LastName	STUDENT	Student's last name	VARCHAR2(20)	NOT NULL
LineItem	FINANCIAL	Unique number associated with the budget line item	NUMBER	NOT NULL
Location	IS_EQUIPMENT_INVENTORY	Location of equipment item	VARCHAR2(50)	NOT NULL
MCTFSSN_ID	MCI_PERSONNEL	Social Security Number which uniquely identifies the instance of a Marine contained in the MCTFS database.	CHAR(9)	NULL
MCTFSSN_ID	MCTF_PERS	Social Security Number which uniquely identifies the instance of a Marine contained in the MCTFS database.	CHAR(9)	NOT NULL
MCTFSSN_ID	STUDENT	Social Security Number which uniquely identifies the instance of a Marine contained in the MCTFS database.	CHAR(9)	NULL
MOS	MCI_PERSONNEL	Primary Military Occupational Specialty (for Military members	VARCHAR2(4)	NOT NULL

Attribute Definition Report
Lists Attributes and Their Definitions for All Data Subjects
02/25/97 8:48 PM
Maj. Slaughter

Attribute Name	Entity Header	Attribute Definition	Column Datatype	Null Option
MOS	MCTF_PERS	Primary MOS of a Marine contained in the MCTFS database.	CHAR(4)	NOT NULL
MOS	STUDENT	Student's primary miliitary occupational specialty	CHAR(4)	NULL
Manager	WAREHOUSE	warehouse manager's first and last name	VARCHAR2(40)	NOT NULL
Material_ID	COPY_MATERIAL	Number which uniquely identifies the copy material	NUMBER	NOT NULL
Material_ID	COURSE_COPY_MATERIAL	Number which uniquely identifies the copy material	NUMBER	NOT NULL
Material_ID	JOB_AID_COPY_MATERIAL	Number which uniquely identifies the copy material	NUMBER	NOT NULL
Material_ID	PROGRAM_COPY_MATERIAL	Number which uniquely identifies the copy material	NUMBER	NOT NULL
MiddleInitial	CUSTOMER	Middle Initial of Customer	CHAR(1)	NULL
MiddleInitial	MCTF_PERS	Middle Initial of a Marine contained in the MCTFS database.	VARCHAR2(1)	NULL
MiddleInitial	STUDENT	Student's middle intitial	CHAR(1)	NULL
Nomenclature	IS_EQUIPMENT_INVENTORY	Nomenclature of equipment item	VARCHAR2(50)	NOT NULL
NumberOfQuestions	EXAM	Number representing the number of questions contained on the exam.	NUMBER	NOT NULL
OccFieldSpec	COURSE_DEVELOPERS	Occupational field specialty associated with a course developer	VARCHAR2(4)	NOT NULL
OnHand	COURSE	Quantity currently on hand, as provided by interface with inventory table	NUMBER	NOT NULL
OnHand	PROGRAM	Quantity currently on hand, as provided by interface	NUMBER	NOT NULL

Attribute Name	Entity Header	Attribute Definition	Column Datatype	Null Option
		with inventory table		
OrdStatDate	PURCHASE	Date of current order status	DATE	NOT NULL
OrderDate	PURCHASE	Date order was placed	DATE	NOT NULL
Order_ID	PURCHASE	Unique invoice number which identifies the order	NUMBER	NOT NULL
PDD	MCI_PERSONNEL	Projected Departure Date	DATE	NOT NULL
PassingScore	EXAM	Number representing the passing score for the exam	NUMBER	NOT NULL
Phone	WAREHOUSE	warehouse phone number	VARCHAR2(7)	NOT NULL
PlatoonCode	MCTF_PERS	Foreign Key which identifies the Platoon Code of a Marine contained in the MCTFS database.	CHAR(4)	NOT NULL
PlatoonCode	STUDENT	Student's USMC platoon code	VARCHAR2(4)	NULL
Pointer	COPY_MATERIAL	A pointer (optional) which indicates the physical location of the original of the material comprises this record. If the material is too large for storage directly in the database, this pointer will indicate its location.	VARCHAR2(20)	NULL
ProgramAbbreviation	PROGRAM	Program Abbreviation as used for MMS updates	VARCHAR2(20)	NOT NULL
Program_ID	FINANCIAL	Program number with version number if applicable	VARCHAR2(6)	NULL
Program_ID	PROGRAM	Program number with version number if applicable	VARCHAR2(6)	NOT NULL
Program_ID	PROGRAM_COPY_MATERIAL	program number associated	VARCHAR2(6)	NOT NULL

Attribute Name	Entity Header	Attribute Definition	Column Datatype	Null Option
		with this material		
Project_ID	ADVERTISMENT	a unique id which identifies an advertising project	NUMBER	NOT NULL
Quantity	INVENTORY		NUMBER	NOT NULL
RDD	PURCHASE	required delivery date	DATE	NULL
Rank	MCI_PERSONNEL	Military Rank or Civilian pay grade	VARCHAR2(6)	NOT NULL
Rank	MCTF_PERS	Rank of a Marine contained in the MCTFS database. This is a calcultaed value. The procedure used to calculate it compares the Grade and MOS to determine the Rank.	VARCHAR2(6)	NOT NULL
ReserveCredits	COURSE	Reserve credits associated with course.	CHAR(8)	NOT NULL
SSN_ID	COURSE_DEVELOPERS	social security number	VARCHAR2(9)	NOT NULL
SSN_ID	MCI_PERSONNEL	social security number	VARCHAR2(9)	NOT NULL
SSN_ID	PROGRAM_DEVELOPERS	social security number	VARCHAR2(9)	NOT NULL
SSN_ID	SSD_PERSONNEL	social security number	VARCHAR2(9)	NOT NULL
SalesRep	PURCHASE	sales rep at the supplier who took the order	VARCHAR2(40)	NULL
SchoolCode	PROGRAM	School code associated with the prgram. Used for MMS purposes. Relates program to a specific resident school (e.g., AWS, etc.)	CHAR(3)	NOT NULL
Section	COURSE_DEVELOPERS	Section that Developer works in	VARCHAR2(20)	NOT NULL
Section	PROGRAM_DEVELOPERS	Section that developer works in	VARCHAR2(20)	NOT NULL
Section	SSD_PERSONNEL	Section that student services department personnel works	VARCHAR2(20)	NOT NULL

Attribute Name	Entity Header	Attribute Definition	Column Datatype	Null Option
		in		
SelToGrade	MCTF_PERS	Grade to which selected of a Marine contained in the MCTFS database.	CHAR(2)	NULL
Serial_No	IS_EQUIPMENT_INVENTORY	Serial Number of equipment item	NUMBER	NOT NULL
State	CUSTOMER	State of Customer's address	CHAR(2)	NOT NULL
State	MCTF_PERS	State of the Home Address for a Marine contained in the MCTFS database. Used as the mailing Address for Reservists	VARCHAR2(2)	NULL
StudentSSN_ID	STUDENT	Social security number of student	VARCHAR2(9)	NOT NULL
StudyHours	COURSE	Study Hours associated with course. Used for transcript generation purposes	VARCHAR2(3)	NULL
StudyHours	PROGRAM	Study Hours associated with program. Used for transcript generation purposes.	VARCHAR2(3)	NULL
Supplier	PURCHASE	Organization suppling the order	VARCHAR2(100)	NOT NULL
Title	COURSE	Title of the course, as defined in the course catalog	VARCHAR2(60)	NOT NULL
Title	PROGRAM	Title of the program, as defined in the course catalog	VARCHAR2(60)	NOT NULL
TrainingProg_ID	TRAINING	a unique ID which identifies a training program	NUMBER	NOT NULL

Attribute Definition Report
Lists Attributes and Their Definitions for All Data Subjects
02/25/97 8:48 PM
Maj. Slaughter

Attribute Name	Entity Header	Attribute Definition	Column Datatype	Null Option
Warehouse_ID	INVENTORY	Unique Id associated with a warehouse. Since several warehouses could be located in the same building, this is not the building number	NUMBER	NOT NULL
Warehouse_ID	WAREHOUSE	Unique Id associated with a warehouse. Since several warehouses could be located in the same building, this is not the building number	NUMBER	NOT NULL
Year	FINANCIAL	Budget Year	VARCHAR2(4)	NOT NULL
ZipCode	CUSTOMER	Zip Cide of customer's address	VARCHAR2(9)	NOT NULL
ZipCode	MCTF_PERS	Zip Code of the Home Address for a Marine contained in the MCTFS database. Used as the mailing Address for Reservists	VARCHAR2(9)	NOT NULL
ZipCode	STUDENT	Student's zipcode	VARCHAR2(9)	NULL

High Level Relationship Definition Report
Physical Relationships, Their Type, Definition, Null Option, and Cardinality
02/25/97 8:53 PM
Maj. Slaughter

Physical Name	Parent Entity	Verb Phrase	Child Entity	Relationship Type	Relationship Definition	Nulls	Cardinality
are_tracked_by	COMPONENTS	are tracked by	INVENTORY	Identifying	components are tracked by inventory records		One-to-Zero-One-or-More
contain	WAREHOUSE	contain	INVENTORY	Identifying	warehouses contain inventory records		One-to-Zero-One-or-More
develops	COURSE_DEVELOPERS	develops	COMPONENTS	Many-Many	course developers develop course components		Many-to-Many
develops	COURSE_DEVELOPERS	develops	COURSE	Many-Many	course developers develop courses		Many-to-Many
develops	COURSE_DEVELOPERS	develops	JOB_AID	Many-Many	course developers develop job aids		Many-to-Many
develops	PROGRAM_DEVELOPERS	develops	COMPONENTS	Many-Many	program developers develop course components		Many-to-Many
develops	PROGRAM_DEVELOPERS	develops	COURSE	Many-Many	a program developer develops programs		Many-to-Many
develops	PROGRAM_DEVELOPERS	develops	PROGRAM	Many-Many	program developers develop programs		Many-to-Many
generates_a	CUSTOMER	generates a	ISSUE_COMPLAINT	Identifying	a customer generates an issue or complaint in the form of a call, letter, e-mail, or walk in.		One-to-Zero-One-or-More
has	COURSE	has	EXAM	Identifying	a course has exams		One-to-Zero-One-or-More
has_many	COURSE	has many	STUDENT	Many-Many	a course has zero, one, ormany enrolled students. A student is enrolled in zero, one, or many courses		Many-to-Many
has_many	MCI_PERSONNEL	has many	EVENTS	Many-Many	An MCI personnel may be involved in many events. An event has many personnel		Many-to-Many
has_many	PROGRAM	has many	STUDENT	Many-Many	a program has zero, one, or many students. A student is enrolled in zero, one, or many programs		Many-to-Many
is_associated_with	COURSE	is associated with	ADVERTISMENT	Many-Many	a course is associated with an advertising project		Many-to-Many
is_associated_with	PROGRAM	is associated with	ADVERTISMENT	Many-Many	a program is associated with an advertising project		Many-to-Many
is_comprised_of	ORDER	is comprised of	COMPONENTS	Many-Many	an order is comprised of components		Many-to-Many

Enterprise Data Model
Exhibit 6, Appendix B

High Level Relationship Definition Report
Physical Relationships, Their Type, Definition, Null Option, and Cardinality
02/25/97 8:53 PM
Maj. Slaughter

Physical Name	Parent Entity	Verb Phrase	Child Entity	Relationship Type	Relationship Definition	Nulls	Cardinality
is_comprised_of	ORDER	is comprised of	COURSE	Many-Many	an order is comprised of courses (does not include enrollments)		Many-to-Many
is_comprised_of	ORDER	is comprised of	JOB_AID	Many-Many	an order is comprised of job aids		Many-to-Many
is_comprised_of	ORDER	is comprised of	PROGRAM	Many-Many	an order is comprised of programs (does not include enrollments)		Many-to-Many
is_for	PURCHASE	is for	COMPONENTS	Many-Many	an order is for course components		Many-to-Many
is_funded_by	COURSE	is funded by	FINANCIAL	Non-identifying	a course is funded by zero,one, or many budget items	Nulls Allowed	Zero-or-One-to-Zero-One-or-More
is_funded_by	PROGRAM	is funded by	FINANCIAL	Non-identifying	a program is funded by zero, one, or many budget items	Nulls Allowed	Zero-or-One-to-Zero-One-or-More
is_part_of	COMPONENTS	is part of	COURSE	Many-Many	a component is part of zero, one, or many courses. A course can one or more components		Many-to-Many
is_part_of	COMPONENTS	is part of	EXAM	Many-Many	a component may be part of zero, one, or many exams. An exam contains components		Many-to-Many
is_part_of	COMPONENTS	is part of	JOB_AID	Many-Many	a component can be part of zero, one or many job aids. A job aid can contain one or more components		Many-to-Many
is_part_of	COMPONENTS	is part of	PROGRAM	Many-Many	a component can be part of zero, one, or many programs. A program can contain one or more components		Many-to-Many
is_part_of	JOB_AID	is part of	COURSE	Many-Many	a job aid can be part of zero, one, or many courses. A course may contain zero, one, or many job aids		Many-to-Many
is_part_of	PROGRAM	is part of	COURSE	Many-Many			Many-to-Many
may_be_a	MCTF_PERS	may be a	MCI_PERSONNEL	Non-identifying	a MCTF Marine may be an	Nulls	Zero-or-One-to-

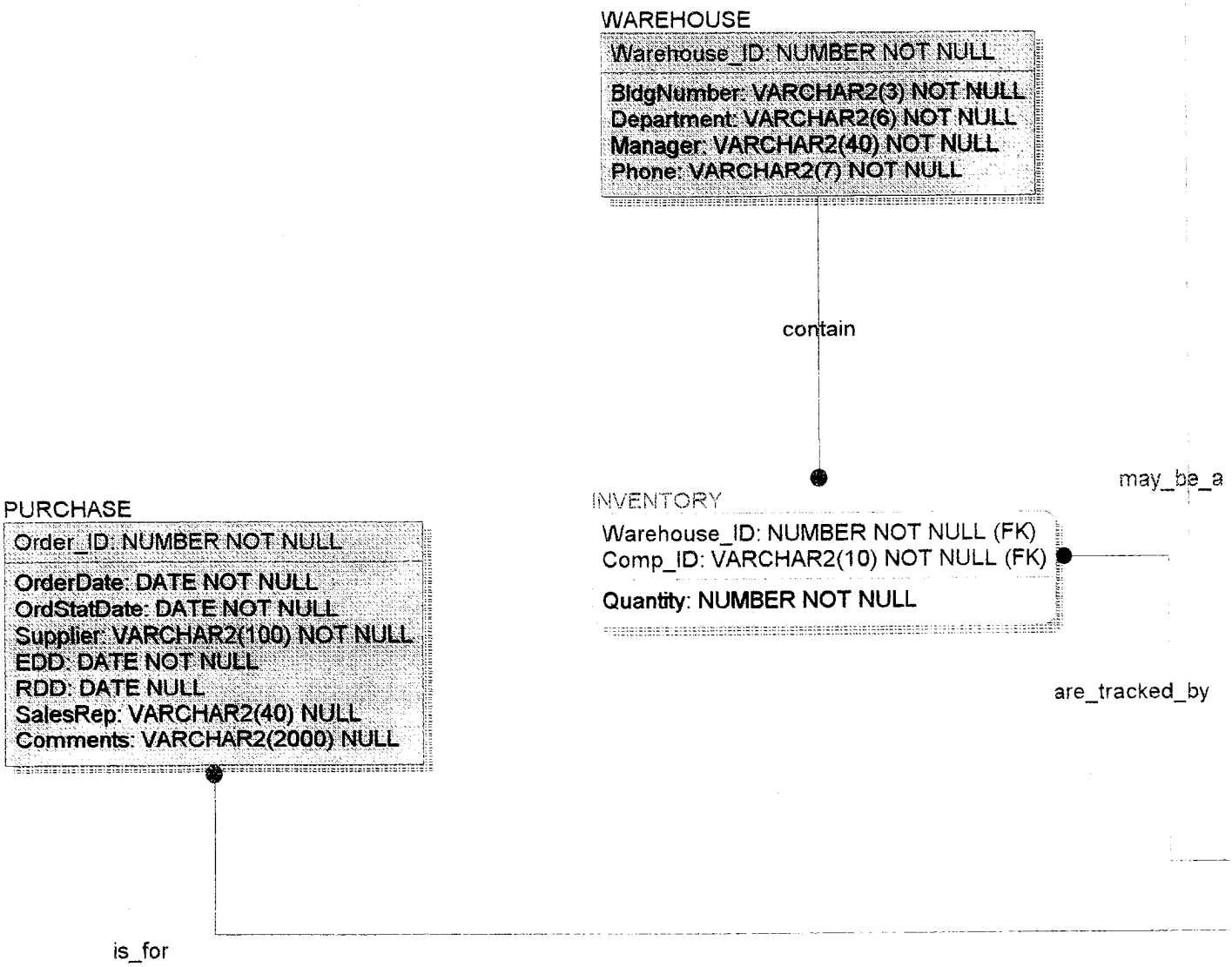
High Level Relationship Definition Report
Physical Relationships, Their Type, Definition, Null Option, and Cardinality
02/25/97 8:53 PM
Maj. Slaughter

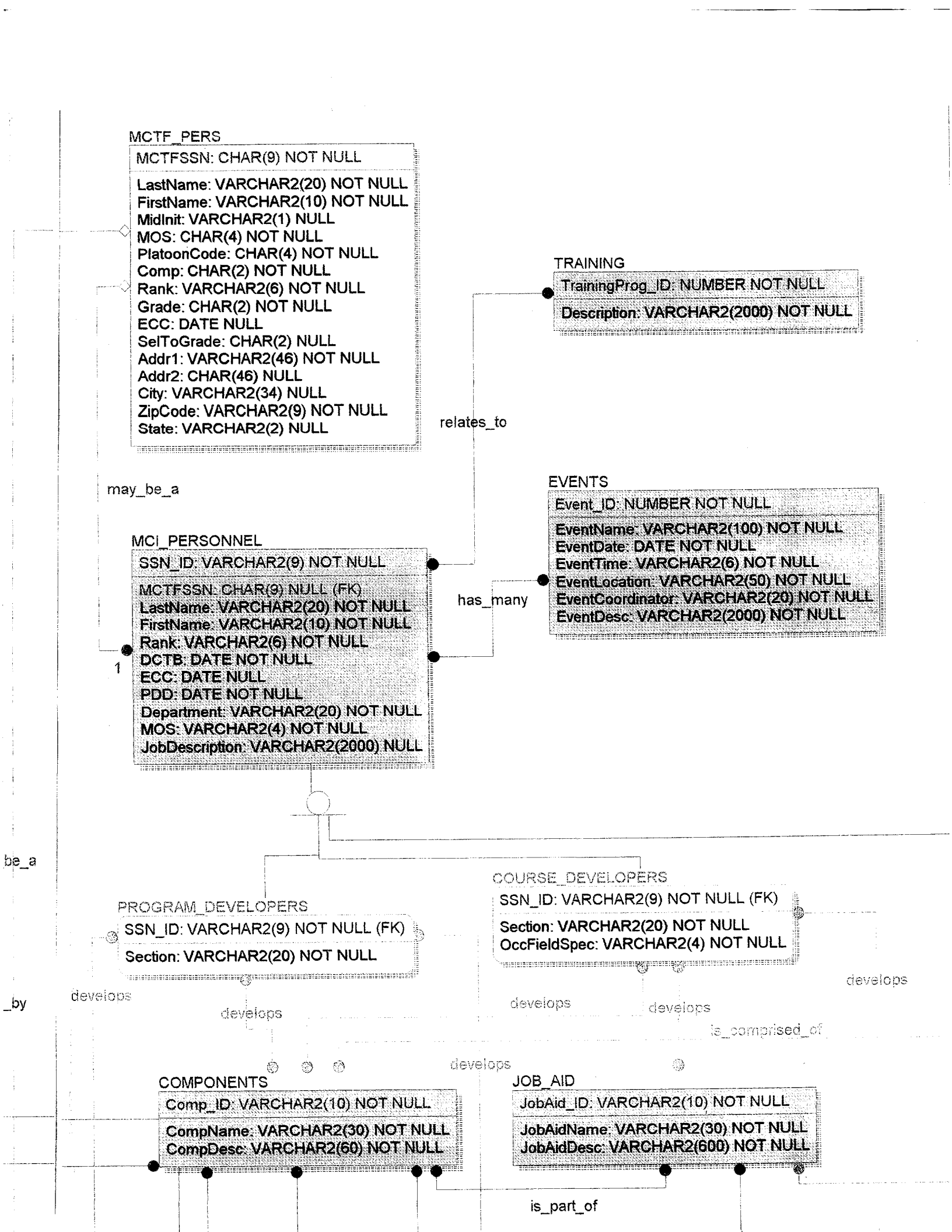
Physical Name	Parent Entity	Verb Phrase	Child Entity	Relationship Type	Relationship Definition	Nulls	Cardinality
					MCI employee	Allowed	Exactly-1
may_be_a	MCTF_PERS	may be a	STUDENT	Non-identifying	A MCTF personnel may be a student	Nulls Allowed	Zero-or-One-to-Exactly-1
may_be_composed_of	COMPONENTS	may be composed of	COPY_MATERIAL	Identifying	A component may be comprised of written material (known as COPY_MATERIAL)		One-to-Zero-One-or-More
places_an	CUSTOMER	places an	ORDER	Identifying	a customer places an order		One-to-Zero-One-or-More
relates_to	TRAINING	relates to	MCI_PERSONNEL	Many-Many	Training is provided to MCI Personnel		Many-to-Many
resolves_an	SSD_PERSONNEL	resolves an	ISSUE_COMPLAINT	Many-Many	an SSD employee resolves an issue or a complaint		Many-to-Many
	COPY_MATERIAL	is a	COURSE_COPY_MATERIAL	Subtype			Is a
	COPY_MATERIAL	is a	JOB_AID_COPY_MATERIAL	Subtype			Is a
	COPY_MATERIAL	is a	PROGRAM_COPY_MATERIAL	Subtype			Is a
	MCI_PERSONNEL	is a	COURSE_DEVELOPERS	Subtype			Is a
	MCI_PERSONNEL	is a	PROGRAM_DEVELOPERS	Subtype			Is a
	MCI_PERSONNEL	is a	SSD_PERSONNEL	Subtype			Is a

MARINE CORPS INSTITUTE
STUDENT SERVICES DIVISION (SSD)
IDEF1X DIAGRAM For HIGH LEVEL VIEW

VERSION 97046 (15 February 1997)
FILE NAME HiLevV97046.ER1
mci2/c:/mci/data model

DEVELOPED BY MAJ. A.T. SLAUGHTER

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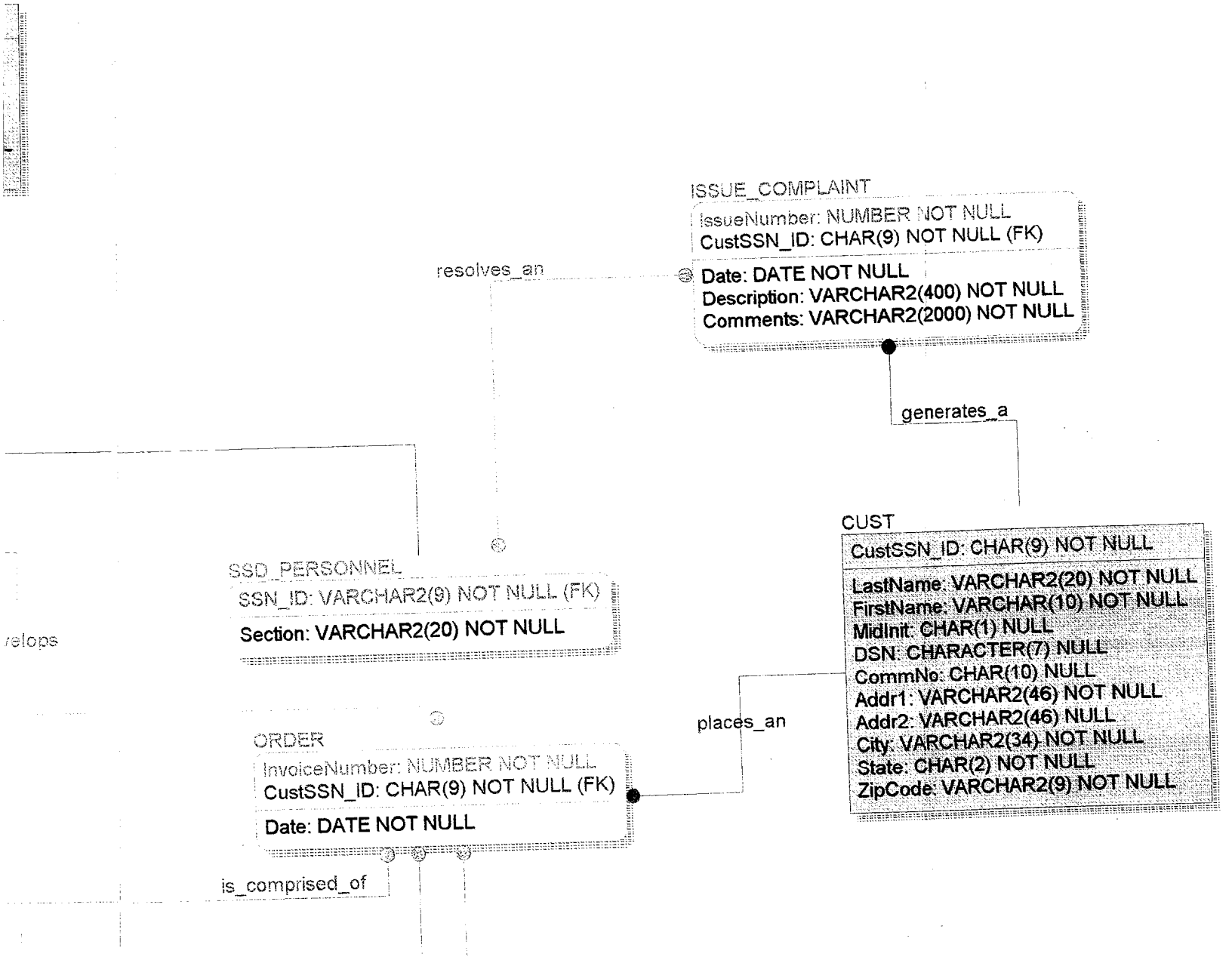
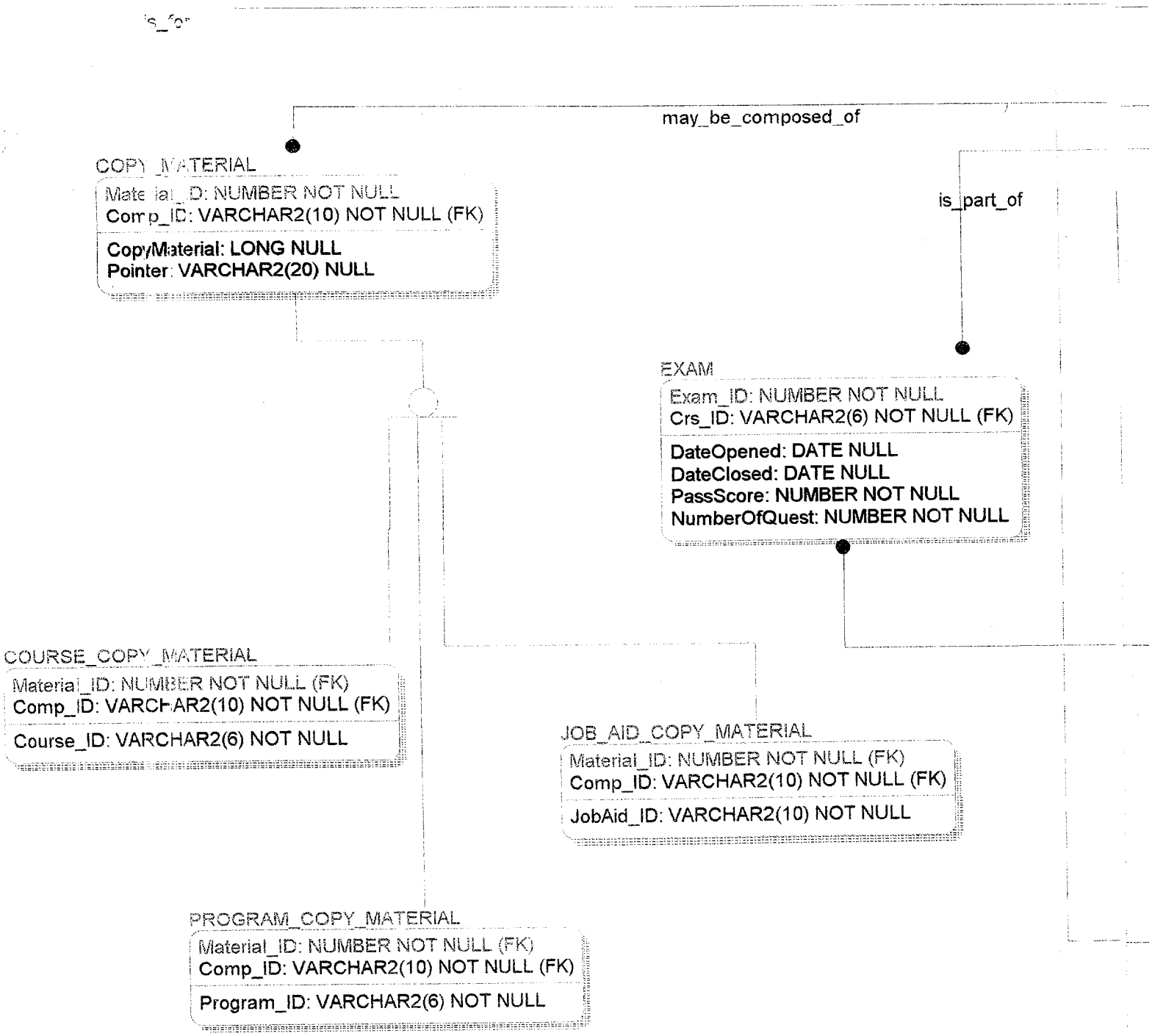
FirstName: VARCHAR2(10) NOT NULL
MidInit: VARCHAR2(1) NULL
MOS: CHAR(4) NOT NULL
PlatoonCode: CHAR(4) NOT NULL
Comp: CHAR(2) NOT NULL
Rank: VARCHAR2(6) NOT NULL
Grade: CHAR(2) NOT NULL
ECC: DATE NULL
SelToGrade: CHAR(2) NULL
Addr1: VARCHAR2(46) NOT NULL
Addr2: CHAR(46) NULL
City: VARCHAR2(34) NULL
ZipCode: VARCHAR2(9) NOT NULL
State: VARCHAR2(2) NULL
TRAINING
TrainingProg_ID: NUMBER NOT NULL
Description: VARCHAR2(2000) NOT NULL
relates_to
may_be_a
EVENTS
Event_ID: NUMBER NOT NULL
EventName: VARCHAR2(100) NOT NULL
EventDate: DATE NOT NULL
EventTime: VARCHAR2(6) NOT NULL
EventLocation: VARCHAR2(50) NOT NULL
EventCoordinator: VARCHAR2(20) NOT NULL
EventDesc: VARCHAR2(2000) NOT NULL
has_many
MCI_PERSONNEL
SSN_ID: VARCHAR2(9) NOT NULL
MCTFSSN: CHAR(9) NULL (FK)
LastName: VARCHAR2(20) NOT NULL
FirstName: VARCHAR2(10) NOT NULL
Rank: VARCHAR2(6) NOT NULL
DCTB: DATE NOT NULL
ECC: DATE NULL
PDD: DATE NOT NULL
Department: VARCHAR2(20) NOT NULL
MOS: VARCHAR2(4) NOT NULL
JobDescription: VARCHAR2(2000) NULL
1
be_a
COURSE_DEVELOPERS
SSN_ID: VARCHAR2(9) NOT NULL (FK)
Section: VARCHAR2(20) NOT NULL
OccFieldSpec: VARCHAR2(4) NOT NULL
PROGRAM_DEVELOPERS
SSN_ID: VARCHAR2(9) NOT NULL (FK)
Section: VARCHAR2(20) NOT NULL
develops
develops
develops
develops
develops
develops
develops
is_comprised_of
_by
COMPONENTS
Comp_ID: VARCHAR2(10) NOT NULL
CompName: VARCHAR2(30) NOT NULL
CompDesc: VARCHAR2(60) NOT NULL
JOB_AID
JobAid_ID: VARCHAR2(10) NOT NULL
JobAidName: VARCHAR2(30) NOT NULL
JobAidDesc: VARCHAR2(600) NOT NULL
is_part_of


ISSUE_COMPLAINT
IssueNumber: NUMBER NOT NULL
CustSSN_ID: CHAR(9) NOT NULL (FK)
Date: DATE NOT NULL
Description: VARCHAR2(400) NOT NULL
Comments: VARCHAR2(2000) NOT NULL
resolves_an
generates_a
CUST
CustSSN_ID: CHAR(9) NOT NULL
LastName: VARCHAR2(20) NOT NULL
FirstName: VARCHAR(10) NOT NULL
MidInit: CHAR(1) NULL
DSN: CHARACTER(7) NULL
CommNo: CHAR(10) NULL
Addr1: VARCHAR2(46) NOT NULL
Addr2: VARCHAR2(46) NULL
City: VARCHAR2(34) NOT NULL
State: CHAR(2) NOT NULL
ZipCode: VARCHAR2(9) NOT NULL
SSD_PERSONNEL
SSN_ID: VARCHAR2(9) NOT NULL (FK)
Section: VARCHAR2(20) NOT NULL
relops
places_an
ORDER
InvoiceNumber: NUMBER NOT NULL
CustSSN_ID: CHAR(9) NOT NULL (FK)
Date: DATE NOT NULL
is_comprised_of

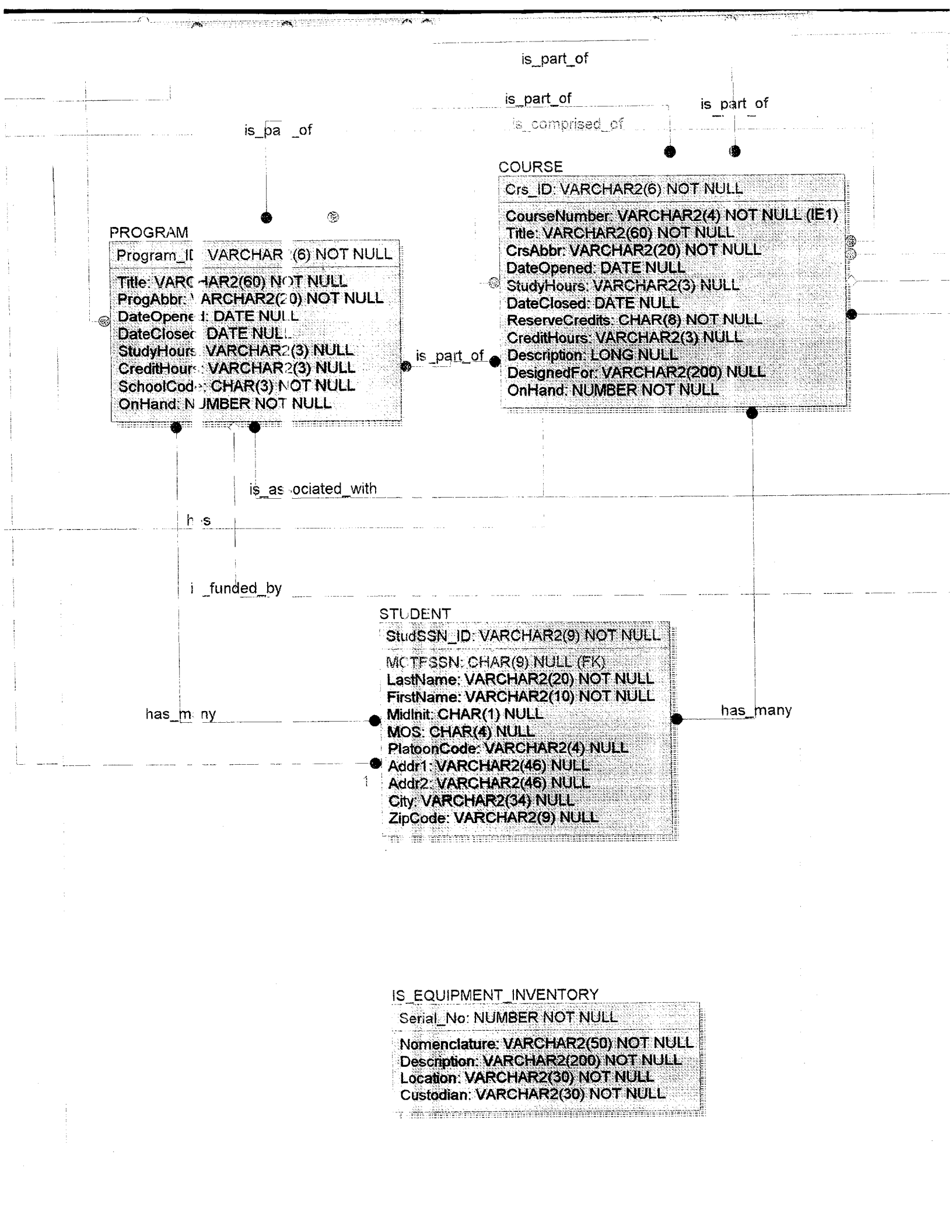


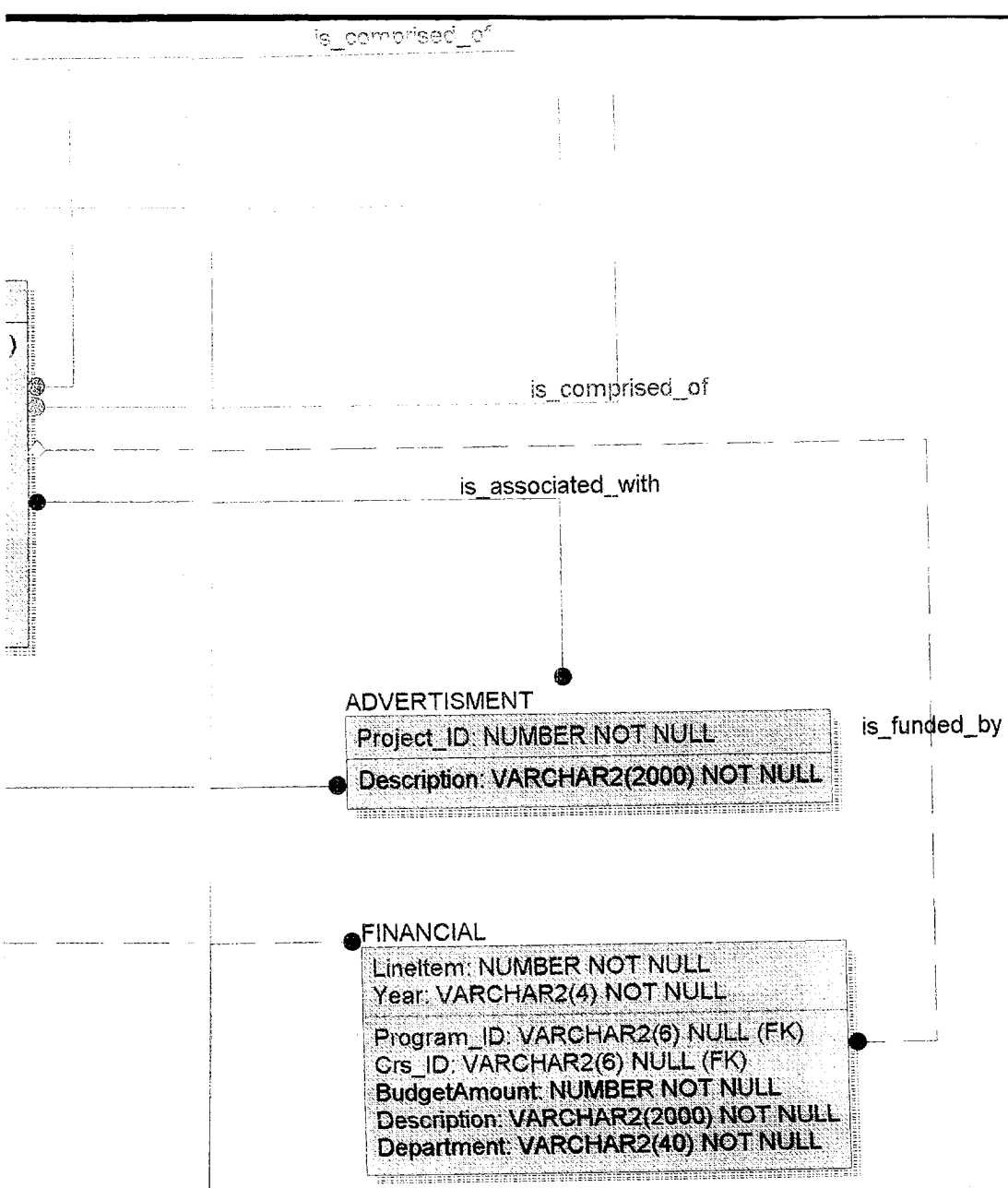
LEGEND:

Silver Tables: Main Entities (COURSE, PROGRAM, STUDENT, COURSE__COMPONENTS)
White Tables: Dependent Entities and Independent Entities other than Main Entities

Blue Relationships: Involve Main Entities
Fuchsia Relationships: Involve Dependent Entities
Green Relationships: Involve Independent Entities other than Main Entities

Blue Attributes: Key/Foreign Key from Main Entity
Fuchsia Attributes: Key/Foreign Key from Dependent Entity
Green Attributes: Key/Foreign Key from Independent Entity other than Main Entity


is_part_of
is_part_of
is_part_of
is_comprised_of
is_pa _of
COURSE
Crs_ID: VARCHAR2(6) NOT NULL
CourseNumber: VARCHAR2(4) NOT NULL (IE1)
Title: VARCHAR2(60) NOT NULL
CrsAbbr: VARCHAR2(20) NOT NULL
DateOpened: DATE NULL
StudyHours: VARCHAR2(3) NULL
DateClosed: DATE NULL
ReserveCredits: CHAR(8) NOT NULL
CreditHours: VARCHAR2(3) NULL
Description: LONG NULL
DesignedFor: VARCHAR2(200) NULL
OnHand: NUMBER NOT NULL
PROGRAM
Program_ID VARCHAR (6) NOT NULL
Title: VARC HAR2(60) NOT NULL
ProgAbbr: ARCHAR2(2 0) NOT NULL
DateOpene d: DATE NULL
DateCloser DATE NULL
StudyHours VARCHAR2(3) NULL
CreditHour VARCHAR2(3) NULL
SchoolCod CHAR(3) NOT NULL
OnHand: N JMBER NOT NULL
is_part_of
is_as ociated_with
h s
i _funded_by
STUDENT
StudSSN_ID: VARCHAR2(9) NOT NULL
MCTFSSN: CHAR(9) NULL (FK)
LastName: VARCHAR2(20) NOT NULL
FirstName: VARCHAR2(10) NOT NULL
MidInit: CHAR(1) NULL
MOS: CHAR(4) NULL
PlatoonCode: VARCHAR2(4) NULL
Addr1: VARCHAR2(46) NULL
Addr2: VARCHAR2(46) NULL
City: VARCHAR2(34) NULL
ZipCode: VARCHAR2(9) NULL
has_m ny
has_many
1
IS_EQUIPMENT_INVENTORY
Serial_No: NUMBER NOT NULL
Nomenclature: VARCHAR2(50) NOT NULL
Description: VARCHAR2(200) NOT NULL
Location: VARCHAR2(30) NOT NULL
Custodian: VARCHAR2(30) NOT NULL



Enterprise Data Model
Exhibit 7, Appendix B

Data Subject vs Organizational Unit

Data Subject \ Organizational Unit	Headquarters	Training & Operations Department	Professional Military Education Department	Occupational Specialty Department	Student Services Department	Management Information Systems Departmei	Logistics Department	Unit Training Representative
Advertisement *Information*		*	*	*				
Components *Information*			*	*			*	
Copy Material *Information*			*	*				
Course *Information*				*	*	*	*	*
Course Copy Material *Information*				*				
Course Developers *Information*			*	*				
Customer *Information*					*		*	*
Events *Information*	*	*	*	*	*	*	*	
Exam *Information*		*	*	*	*	*		
Financial *Information*	*	*						
Inventory *Information*							*	
IS Equipment Inventory *Information*						*		
Issue Complaint *Information*			*		*			
Job Aid *Information*				*	*		*	*
Job Aid Copy Material *Information*				*				
MCI Personnel *Information*	*	*						
MCTFS Personnel *Information*	*	*			*	*		
Order Information					*		*	*
Program *Information*			*		*	*	*	*
Program Copy Material *Information*			*					
Program Developers *Information*			*					
Purchase *Information*					*		*	
SSD Personnel *Information*					*			
Student *Information*					*	*	*	*
Training *Information*		*						
Warehouse *Information*					*		*	

Updated: 17 Feb 1997

Data Subject vs Location

Data Subject \ Location	MCI Building 1st Floor	MCI Building 2nd Floor	Marine Barracks	MCI Warehouse	Using Unit
Advertisement *Information*	*	*			
Components *Information*	*	*		*	
Copy Material *Information*	*	*			
Course *Information*	*	*			*
Course Copy Material *Information*	*				
Course Developers *Information*	*	*			
Customer *Information*		*			
Events *Information*	*	*	*	*	
Exam *Information*	*	*			*
Financial *Information*		*			
Inventory *Information*				*	
IS Equipment Inventory *Information*		*			
Issue Complaint *Information*		*			
Job Aid *Information*	*	*			*
Job Aid Copy Material *Information*	*				
MCI Personnel *Information*	*	*	*	*	
MCTFS Personnel *Information*		*	*		
Order Information		*		*	*
Program *Information*		*			*
Program Copy Material *Information*		*			
Program Developers *Information*		*			
Purchase *Information*		*		*	
SSD Personnel *Information*		*			
Student *Information*		*			*
Training *Information*		*			
Warehouse *Information*		*		*	

Updated: 17 Feb 1997

FUNCTION / DATA SUBJECT	Planning				Budgeting				Training				Advertising				Analysis of Effectiveness				Program Design		
Advertisement *Information*													C	R	U	D		R				R	
Components *Information*						R												R				R	
Copy Material *Information*										R								R				R	
Course *Information*						R								R				R			C	R	U
Course Copy Material *Information*																		R				R	
Course Developers *Information*																		R			C	R	U
Customer *Information*																							
Events *Information*	C	R	U	D																			
Exam *Information*																		R				R	
Financial *Information*					C	R	U	D		R				R								R	
Inventory *Information*																		R					
IS Equipment Inventory *Information*						R																	
Issue Complaint *Information*																							
Job Aid *Information*						R				R				R									
Job Aid Copy Material *Information*																							
MCI Personnel *Information*		R								R													
MCTFS Personnel *Information*																							
Order Information						R																	
Program *Information*						R				R				R				R			C	R	U
Program Copy Material *Information*																		R				R	
Program Developers *Information*																		R			C	R	U
Purchase *Information*						R								R									
SSD Personnel *Information*																							
Student *Information*																		R					
Training *Information*									C	R	U	D										R	
Warehouse *Information*						R																	

C - Create	R - Read	D - Delete
U - Update		A - Archive

Enterprise Data Model
Exhibit 10, Appendix B

	Advertising				Analysis of Effectiveness				Program Design				Program Writing			
	C	R	U	D		R				R						
						R				R			C	R	U	D
						R				R			C	R	U	A
		R				R			C	R	U	A		R	U	
						R				R			C	R	U	D
						R			C	R	U	D		R		
						R				R			C	R	U	A
		R								R						
						R										
		R														
		R				R			C	R	U	A		R	U	
						R				R			C	R	U	D
						R			C	R	U	D		R		
		R														
						R										
										R				R		

C - Create	R - Read	D - Delete
U - Update		A - Archive

Program Staffing	Program Revising	Course Design	Course Writing	Course Staffing
R		R		R
R	R U	R	C R U D	R
R		R	C R U A	R
R	R U	C R U A	R U	R
R	R U	R	C R U A	R
R	R	C R U D	R	R
R	R U	R	C R U A	R
		R		
		R	C R U D	R
		R	C R U D	R
R	R U			
R	R U			
R	R			
R				R
	R	R	R	

e Data Model
, Appendix B

CRUD Matrix
Data Subject vs Function

	Course Staffing	Course Revising	Editing	Layout & Graphics	Repro Servicing	Student Activity Transactions	Grading	Customer Servicing	Registrar Servicing
	R							R	
D	R	R U	R	R U	R	R		R	
A	R	R U	R U	C R U A	R				
	R	R U	R	R	R	R	R	R	R
A	R	R U	R U	R U	R				
	R	R	R	R					
						R		C R U D	
A	R	R U	R U	R	R	R	R	R	R
					R				R
						R		R	
								C R U D	
D	R	R U	R	R	R	R		R	
D	R	R U	R U	R U	R				
						R	R	R	R
						R U		C R U D	
			R	R	R	R	R	R	R
			R U	R U	R				
			R	R					
	R				C R U D	R		R	
						C R U A	R U	C R U A	R U
		R	R	R					

ıtrix
Function

ıer ng	Registrar Servicing	Manage Networks	Programming	Database Administration	Ordering	Receiving	Storing	Inventory	Packaging
				R					
			R	R	R	R	R	R	R
			R						
	R		R	R			R	R	R
			R	R					
				R					
U D			R	R					
	R		R	R					
	R	R	R		R	R		R	R
			R		R U	R U	R U	C R U D	R U
		C R U D	R	R					
U D			R	R					
			R	R	R	R	R	R U	R
			R						
			R						
	R		C R U D	R					
U D			R	R					
	R		R	R			R	R	R
			R	R					
				R					
			R	R	C R U D	R U	R	R U	
			R	R					
U A	R U		R	R					
			R	R					
			R				R U	C R U D	

entory			Packaging			Delivering			Disposing			Unit Reconciling			Exam Proctoring			Parade			Personnel Administration			FUNCTIO
																								Advertisemen
R			R			R			R															Components
																								Copy Material
R			R			R			R			R			R									Course *Inform*
																								Course Copy
						R						R										R		Course Develo
																								Customer *Info*
			R			R			R						R			R	U					Events *Informa*
R			R			R																		Exam *Informa*
R	U	D	R	U		R	U		R	U														Financial *Infor*
																								Inventory *Infor*
																								IS Equipment
R	U		R			R			R			R												Issue Complai
																								Job Aid *Inform*
																								Job Aid Copy
																					C	R	U	D MCI Personnel
R			R			R						R												MCTFS Perso
			R									R												Order Informat
									R															Program *Infor*
																								Program Copy
R	U																					R		Program Deve
																								Purchase *Infor*
						R						R			R						C	R	U	D SSD Personne
																								Student *Inform*
R	U	D							R													R		Training *Inform*
																								Warehouse *Inf*

C - Create	R - Read	D - Delete
U - Update		A - Archive

Enterprise D
Exhibit 10, A

posing			Unit Reconciling				Exam Proctoring				Parade				Personnel Administration				FUNCTION / DATA SUBJECT
																			Advertisement *Information*
R																			Components *Information*
																			Copy Material *Information*
R				R				R											Course *Information*
																			Course Copy Material *Information*
																R			Course Developers *Information*
				R															Customer *Information*
												R	U						Events *Information*
R								R											Exam *Information*
																			Financial *Information*
R	U																		Inventory *Information*
																			IS Equipment Inventory *Information*
																			Issue Complaint *Information*
R				R															Job Aid *Information*
																			Job Aid Copy Material *Information*
															C	R	U	D	MCI Personnel *Information*
																			MCTFS Personnel *Information*
				R															Order Information
				R															Program *Information*
R																			Program Copy Material *Information*
																R			Program Developers *Information*
																			Purchase *Information*
															C	R	U	D	SSD Personnel *Information*
				R				R											Student *Information*
																R			Training *Information*
R																			Warehouse *Information*

R - Read	D - Delete
	A - Archive

Enterprise Data Model
Exhibit 10, Appendix B

Appendix C.
Preliminary Business Model Exhibits

CR M
Function v

Functional Areas	Functions \ Data Subject	Advertisement *Information*	Components *Information*	Copy Material *Information*	Course *Information*	Course Copy Material *Information*	Course Developers *Information*	Customer *Information*	Events *Information*	Exam *Information*	Financial *Information*	Inventory *Information*	IS Equipment Inventory *Information*	Issue Complaint *Information*	Job Aid *Information*
Headquarters Support	Personnel Administration						R								
	Parade								C						
	Planning								C						
Course Management	Budgeting		R		R						C		R		R
	Training			R							R				R
	Advertising	C			R						R				R
	Analysis of Effectiveness	R	R	R	R	R	R			R		R			
Course Development	Program Design	R	R	R	C	R	C			R	R				
	Program Writing		C	C	C	C	R			C					
	Program Staffing	R	R	R	R	R	R			R					
	Program Revising		C		C	C	R			C					
	Course Design	R	R	R	C	R	C			R	R				R
	Course Writing		C	C	C	C	R			C					C
	Course Staffing	R	R	R	R	R	R			R					R
	Course Revising		C		C	C	R			C					C
	Editing		R	C	R	C	R			C					R
	Layout & Graphics		C	C	R	C	R			R					R
	Reproduction Servicing		R	R	R	R				R	R				R
Student Servicing	Student Activity Transactions		R		R			R		R		R			R
	Grading				R					R					
	Customer Servicing	R	R		R			C		R		R		C	R
	Registrar Servicing				R					R	R				
Information Systems Management	Manage Networks										R		C		
	Programming		R	R	R	R		R		R	R	R	R	R	R
	Database Administration	R	R		R	R	R	R		R			R	R	R
Warehouse and Distribution	Ordering		R								R	C			R
	Receiving		R								R	C			R
	Storing		R		R							C			R
	Inventory		R		R						R	C			R
	Packaging		R		R					R	R	C			R
	Delivering		R		R			R		R	R	C			R
	Disposing		R		R					R		C			R
Unit Interaction	Unit Reconciling				R			R							R
	Exam Proctoring				R					R					

Symbols	
C	Create or Update
R	Read or Retrieve

CR Matrix
Function vs Data Subject

Exam *Information*	Financial *Information*	Inventory *Information*	IS Equipment Inventory *Information*	Issue Complaint *Information*	Job Aid *Information*	Job Aid Copy Material *Information*	MCI Personnel *Information*	MCTFS Personnel *Information*	Order Information	Program *Information*	Program Copy Material *Information*	Program Developers *Information*	Purchase *Information*	SSD Personnel *Information*	Student *Information*	Training *Information*	Warehouse *Information*	Data Subject / Functions
							C					R		C		R		Personnel Administration
																		Parade
							R											Planning
	C		R		R				R	R			R				R	Budgeting
	R				R		R			R						C		Training
	R				R					R			R					Advertising
R		R								R	R	R			R			Analysis of Effectiveness
R	R									C	R	C				R		Program Design
C										C	C	R				R		Program Writing
R										R	R	R	R					Program Staffing
C										C	C	R				R		Program Revising
R	R				R	R										R		Course Design
C					C	C										R		Course Writing
R					R	R							R					Course Staffing
C					C	C										R		Course Revising
C					R	C				R	C	R				R		Editing
R					R	C				R	C	R				R		Layout & Graphics
R	R				R	R				R	R		C					Reproduction Servicing
R		R			R			R	C	R			R		C			Student Activity Transactions
R								R		R					C			Grading
R		R		C	R			R	C	R			R		C			Customer Servicing
R	R							R		R					C			Registrar Servicing
	R		C															Manage Networks
R	R	R	R	R	R	R	R	C	R	R	R		R	R	R	R	R	Programming
R			R	R	R			R	R	R	R	R	R	R	R	R		Database Administration
	R	C			R								C					Ordering
	R	C			R								C					Receiving
		C			R					R			R				C	Storing
	R	C			R				R				C				C	Inventory
R	R	C			R				R	R								Packaging
R	R	C			R				R						R		R	Delivering
R		C			R					R							R	Disposing
					R				R	R					R			Unit Reconciling
R															R			Exam Proctoring

Preliminary Business Model
Exhibit 1, Appendix C

Clustered CR Matrix

Functional Areas	Functions \ Data Subject	MCI Personnel *Information*	SSD Personnel *Information*	Events *Information*	Financial *Information*	Training *Information*	Advertisement *Information*	Program *Information*	Program Developers *Information*	Course *Information*	Course Developers *Information*	Program Copy Material *Information*	Exam *Information*	Copy Material *Information*	Course Copy Material *Information*	Components *Information*	Job Aid Copy Material *Information*	Job Aid *Information*
Headquarters Support	Personnel Administration	C	C			R			R		R							
	Parade Support			C														
	Planning	R		C														
Course Management	Budgeting				C			R		R						R		R
	Training	R			R	C		R						R				R
	Advertising				R		C	R		R								R
	Analysis of Effectiveness						R	R	R	R	R	R	R	R	R	R		
	Program Staffing						R	R	R	R	R	R	R	R	R	R		
	Course Staffing						R			R	R		R	R	R	R	R	R
Course Development	Program Design				R	R	R	C	C	C	C	R	R	R	R	R		
	Program Writing					R		C	R	C	R	C	C	C	C	C		
	Program Revising					R		C	R	C	R	C	C		C	C		
	Layout & Graphics					R		R	R	R	R	C	R	C	C	C	C	R
	Editing					R		R	R	R	R	C	C	C	C	R	C	R
	Course Design				R	R	R			C	C		R	R	R	R	R	R
	Course Writing					R				C	R		C	C	C	C	C	C
	Course Revising					R				C	R		C		C	C	C	C
Student Servicing	Customer Servicing						R	R		R			R			R		R
	Student Activity Transactions							R		R			R			R		R
	Grading							R		R			R					
	Registrar Servicing				R			R		R			R					
Warehouse and Distribution	Inventory				R					R						R		R
	Reproduction Servicing				R			R		R		R	R	R	R	R	R	R
	Ordering				R											R		R
	Receiving				R											R		R
	Storing							R		R						R		R
	Delivering				R					R			R			R		R
	Packaging				R			R		R			R			R		R
	Disposing							R		R			R			R		R
Information Systems Management	Programming	R	R		R	R		R		R		R	R	R	R	R	R	R
	Database Administration		R			R	R	R	R	R	R	R	R		R	R		R
	Manage Networks				R													
Unit Interaction	Unit Reconciling							R		R								R
	Exam Proctoring									R			R					

Symbols	
C	Create or Update
R	Read or Retrieve

Clustered CR Matrix

Training Information	Advertisement Information	Program Information	Program Developers Information	Course Information	Course Developers Information	Program Copy Material Information	Exam Information	Copy Material Information	Course Copy Material Information	Components Information	Job Aid Copy Material Information	Job Aid Information	Student Information	Customer Information	Order Information	Issue Complaint Information	Purchase Information	Inventory Information	Warehouse Information	MCTFS Personnel Information	IS Equipment Inventory Information	Data Subject / Sub-Systems
			R		R																	Personnel Admin
																						Ceremonial
		R		R						R		R			R		R		R		R	Program and Course Management
		R						R				R										
	C	R		R								R					R					
	R	R	R	R	R	R	R	R	R	R			R						R			
	R	R	R	R	R	R	R	R	R	R								R				
	R			R	R		R	R	R	R	R	R						R				
	R	C	C	C	C	R	R	R	R	R												Program and Course Development
		C	R	C	R	C	C	C	C	C												
		C	R	C	R	C	C		C	C												
		R	R	R	R	C	R	C	C	C	C	R										
		R	R	R	R	C	C	C	C	R	C	R										
	R			C	C		R	R	R	R	R	R										
				C	R		C	C	C	C	C	C										
				C	R		C		C	C	C	C										
	R	R		R			R			R		R	C	C	C	C	R	R		R		Student Service Support
		R		R			R			R		R	C	R	C		R	R		R		
		R		R			R						C							R		
		R		R			R						C							R		
				R						R		R			R		C	C	C			Warehouse and Distribution
		R		R		R	R	R	R	R	R	R					C					
										R		R					C	C				
										R		R					C	C				
		R		R						R		R					R	C	C			
				R			R			R		R	R	R	R			C	R			
		R		R			R			R		R			R			C				
		R		R			R			R		R						C	R			
		R		R		R	R	R	R	R	R	R	R	R	R	R	R	R	R	C	R	Information Systems Management
	R	R	R	R	R	R	R		R	R		R	R	R	R	R	R			R	R	
																					C	
		R		R								R	R	R	R							Unit Interaction
				R			R						R									

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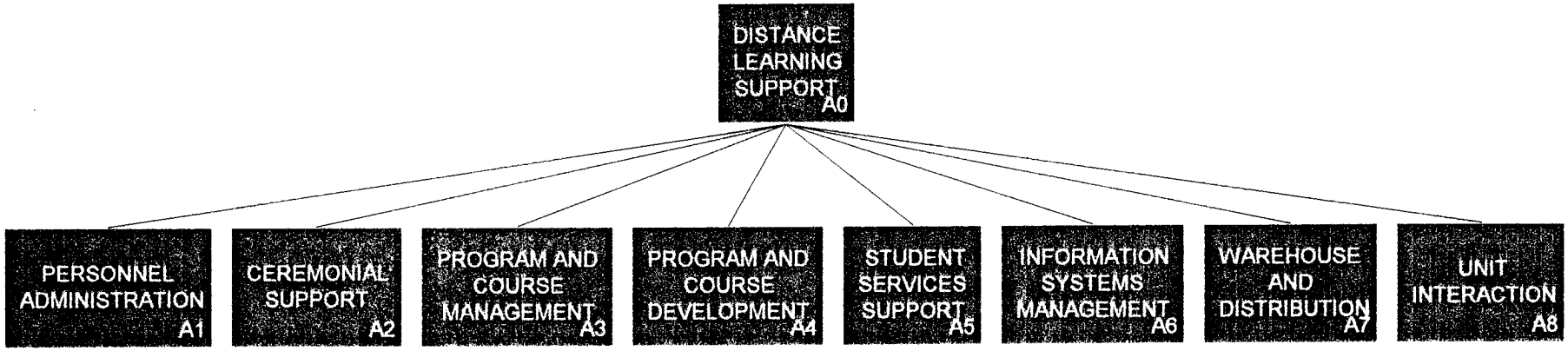

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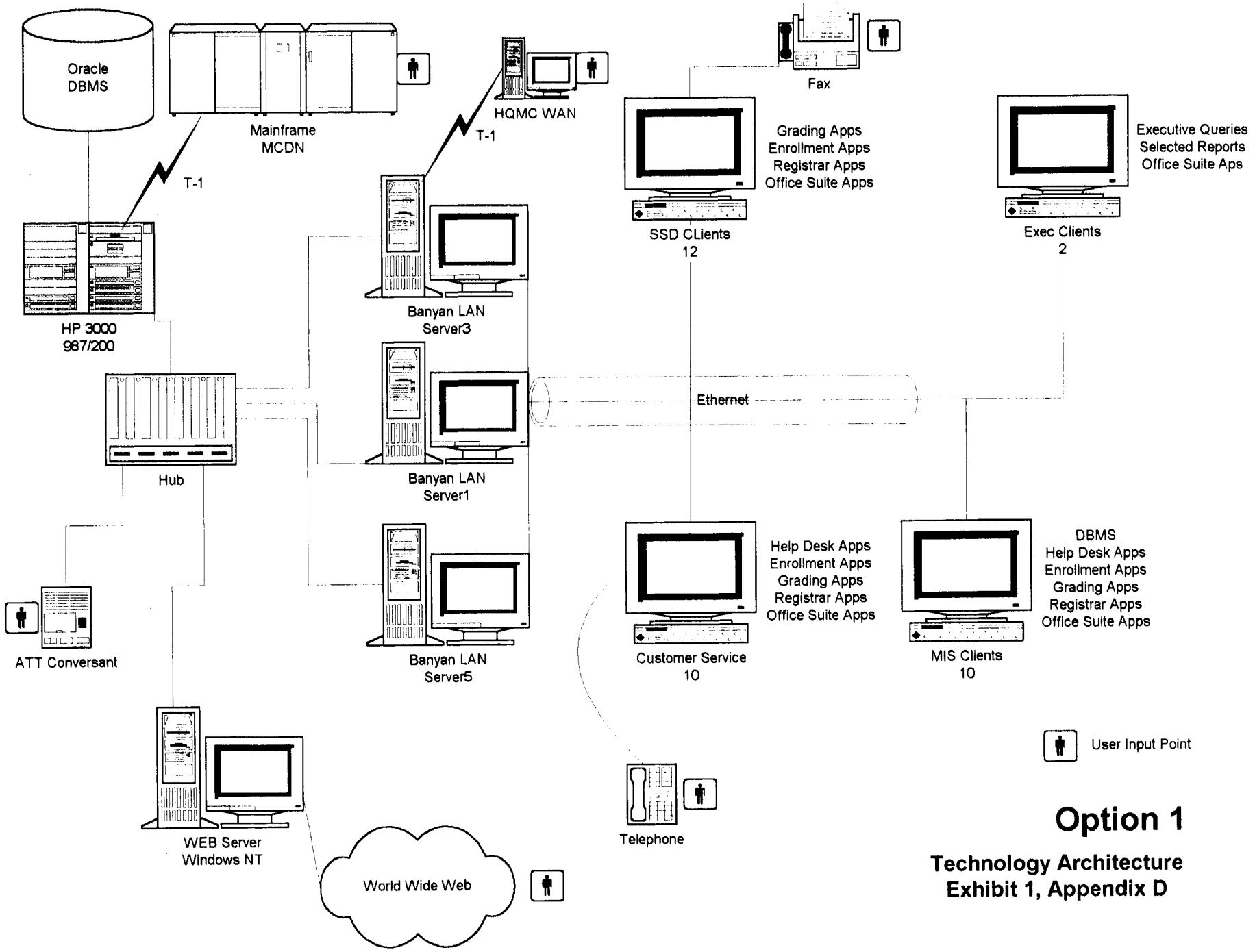
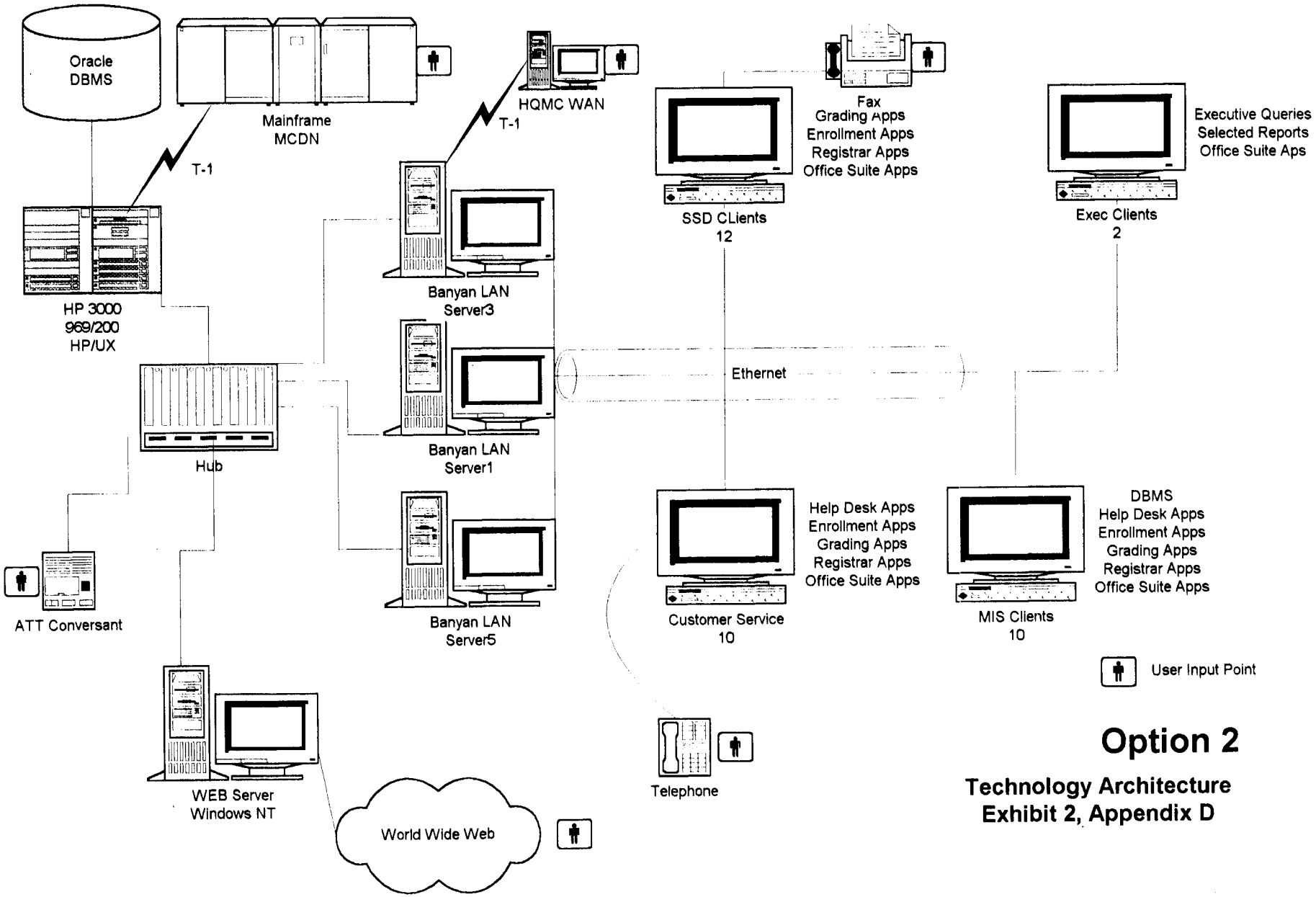
Appendix D.
Technology Architecture Exhibits



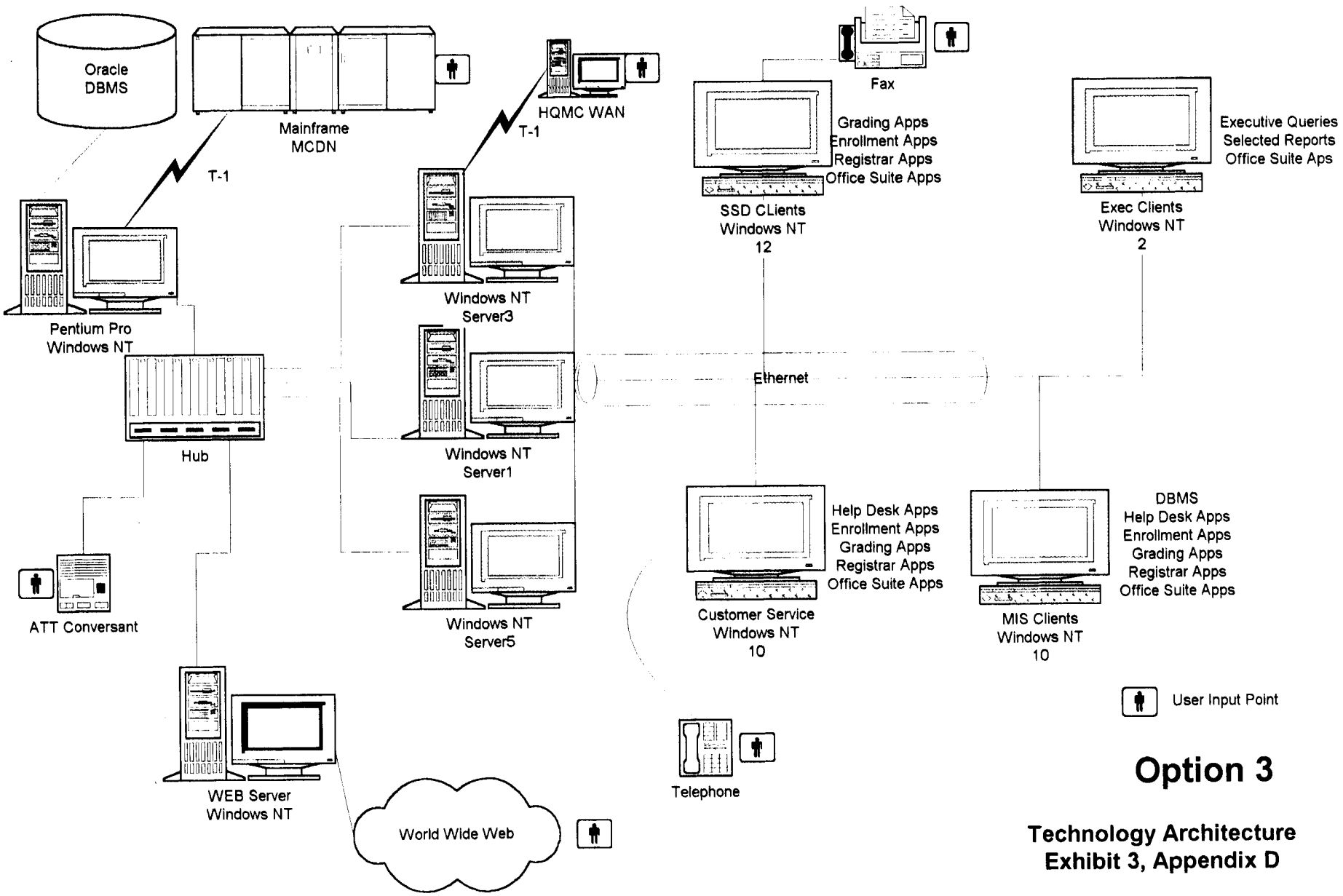
Option 1

Technology Architecture
Exhibit 1, Appendix D



Option 2

Technology Architecture
Exhibit 2, Appendix D



Option 3

Technology Architecture
Exhibit 3, Appendix D

Cost Worksheet Option One
HP Minicomputer Server Running MPE/iX

Hardware	
Server HP 987/200	169,613
Client Pentium	2,500
Operating System	
Server MPE/ix V5.5	38,531
Client Windows 95	0
DBMS	
Server Oracle 7.3 Dual Processor	38,200
Client Oracle Apps	0
Support	
Server	21,933
Client	0
Development	
Hardware	9,000
Software	36,705
Peopleware	360,000
Migration	
Hardware	TBD
Software	TBD
Peopleware	TBD
Development Training	
Peopleware	25,000
Total	701,482

Hardware	
Server HP 987/150	108,332
Client Pentium	2,500
Operating System	
Server MPE/ix V5.5	38,531
Client Windows 95	0
DBMS	
Server Oracle 7.3 Single Processor	19,100
Client Oracle Apps	0
Support	
Server	21,933
Client	0
Development	
Hardware	9,000
Software	36,705
Peopleware	360,000
Migration	
Hardware	TBD
Software	TBD
Peopleware	TBD
Development Training	
Peopleware	25,000
Total	621,101

Hardware	
Server HP 987	69,464
Client Pentium	2,500
Server MPE/ix V5.5	38,531
Client Windows 95	0
DBMS	
Server Oracle 7.3 Single Processor	19,100
Client Oracle Apps	0
Support	
Server	21,933
Client	0
Development	
Hardware	9,000
Software	36,705
Peopleware	360,000
Migration	
Hardware	TBD
Software	TBD
Peopleware	TBD
Development Training	
Peopleware	25,000
Total	582,233

Technology Architecture
Exhibit 4, Appendix D

Cost Worksheet Option Two
HP Minicomputer Server Running UNIX (HP/UX)

Hardware	
Server HP 969/200	109,160
Client Pentium	2,500
Operating System	
Server HP/UX	33,906
Client Windows 95	0
DBMS	
Server Oracle 7.3 Dual Processor	38,200
Client Oracle Apps	0
Support	
Server	28,161
Client	0
Development	
Hardware	9,000
Software	36,705
Peopleware	360,000
Migration	
Hardware	TBD
Software	TBD
Peopleware	TBD
Development Training	
Peopleware	25,000
Total	642,632

Hardware	
Server HP 969/100	94,160
Client Pentium	2,500
Operating System	
Server HP/UX	33,906
Client Windows 95	0
DBMS	
Server Oracle 7.3 Single Processor	19,100
Client Oracle Apps	0
Support	
Server	28,161
Client	0
Development	
Hardware	9,000
Software	36,705
Peopleware	360,000
Migration	
Hardware	TBD
Software	TBD
Peopleware	TBD
Development Training	
Peopleware	25,000
Total	608,532

Cost Worksheet Option 3
Intel Based Server Running NT

Hardware	
Server Pentium Pro	40,000
Client Pentium	2,500
Operating System	
Server Windows NT	2,190
Client Windows NT	7,752
DBMS	
Server Oracle 7.3 Dual Processor	38,200
Client Oracle Apps	0
Support	
Server	TBD
Client	0
Development	
Hardware	9,000
Software	36,705
Peopleware	360,000
Migration	
Hardware	TBD
Software	TBD
Peopleware	TBD
Development Training	
Peopleware	25,000
Total	521,347

Cost Worksheet Option 3
Intel Based Server Running NT

Hardware	
Server Pentium Pro	40,000
Client Pentium	2,500
Operating System	
Server Windows NT	2,190
Client Windows NT	7,752
DBMS	
Server Oracle 7.3 Dual Processor	38,200
Client Oracle Apps	0
Support	
Server	TBD
Client	0
Development	
Hardware	9,000
Software	36,705
Peopleware	360,000
Migration	
Hardware	TBD
Software	TBD
Peopleware	TBD
Development Training	
Peopleware	25,000
Total	521,347

Hardware	
Server Pentium Pro	40,000
Client Pentium	2,500
Operating System	
Server Windows NT	2,190
Client Windows NT	7,752
DBMS	
Server Oracle 7.3 Dual Processor	38,200
Client Oracle Apps	0
Support	
Server	TBD
Client	0
Development	
Hardware	9,000
Software	36,705
Peopleware	360,000
Migration	
Hardware	TBD
Software	TBD
Peopleware	TBD
Development Training	
Peopleware	25,000
Total	521,347

Technology Architecture
Exhibit 4, Appendix D

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